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**ENVIRONMENTAL  
RESTORATION  
PROGRAM**

**Surface Radiological Investigations  
at White Wing Scrap Yard,  
Oak Ridge Reservation,  
Oak Ridge, Tennessee**

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Environmental Restoration Division  
ORNL Environmental Restoration Program

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Oak Ridge Reservation, Oak Ridge, Tennessee

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## EXECUTIVE SUMMARY

A surface radiological scoping survey of accessible areas at the White Wing Scrap Yard [Waste Area Grouping 11 (WAG 11)] was conducted intermittently from December 1989 through July 1991 by members of the Measurement Applications and Development Group, Health and Safety Research Division, Oak Ridge National Laboratory (ORNL) at the request of Environmental Restoration Program personnel at ORNL. The White Wing Scrap Yard is an estimated 30-acre, predominately wooded area located on the western edge of East Fork Ridge in the McNew Hollow area on the U.S. Department of Energy's Oak Ridge Reservation. The scrap yard was formerly used for aboveground storage of contaminated material (e.g., steel tanks, metal, glass, concrete, and miscellaneous industrial trash) from the Oak Ridge K-25 Site, Oak Ridge Y-12 Plant, and ORNL. The purposes of this cursory investigation were (1) to provide an updated contamination status of the site by locating and interpreting the presence, nature, and extent of surface radiological contamination and (2) to provide a basis for the formulation of interim corrective action to limit human exposures to radioactivity and minimize the potential for contaminant dispersion. It should be noted that several corrective action measures have been taken as a result of preliminary findings of this survey.

Surface radiation measurements and visual inspections have identified a variety of radiological and physical hazards. In general, the site exhibited widespread clusters of localized radioactive hot spots throughout the accessible areas. The most numerous and concentrated regions of contamination encompassing several grid blocks were found north of Hot Yard Road. Results show grid block location 1+00, 700L to be the most contaminated block north of Hot Yard Road. Three localized surface hot spots with gamma exposure rates of 12, 6.2, and 1.5 mR/h were identified. Physical hazards include sharp pieces of metal and broken glass on the ground surface.

Sample analysis results demonstrate high concentrations of uranium in most of the samples. The presence and nature of uranium contamination (i.e., uranium enriched in the isotope  $^{235}\text{U}$ ) suggests this type of waste originated from the K-25 Site or Y-12 Plant. However, results of sample analysis from the 12-mR/h hot spot, located at the former K-25 scrapping operations area, revealed  $^{137}\text{Cs}$  concentrations of up to 21,000 pCi/g. The presence of elevated concentrations of  $^{238}\text{U}$  in soil taken south of Hot Yard Road (former ORNL scrapping operations area) and elevated concentrations of  $^{137}\text{Cs}$  northwest of Hot Yard Road (former K-25 scrapping operations area) suggest designated scrapping operational boundaries were not strictly adhered to and/or these facilities managed a variety of radionuclides. Chemical analysis of three soil samples collected from a dead-vegetation region north of Hot Yard Road demonstrates the presence of polychlorinated biphenyls (PCBs) at concentrations of ~10 ppm per sample.

Survey results show the presence of residual contamination in soil and radioactively contaminated debris on the ground surface (i.e., elevated concentrations of  $^{238}\text{U}$  and  $^{137}\text{Cs}$ ). Although past cleanup activities such as scrap removal and remediation of localized areas of contaminated soil were conducted at the scrap yard site, these survey results demonstrate that previous cleanup operations were insufficient and that commingled scrap

material and radioactive residues are prevalent. Additionally, without stringent access control measures at the perimeter of the WAG 11 boundary (i.e., fence barrier with restricted access), a potential risk to inadvertent intruders exists. Although no vegetation samples were collected for radionuclide analysis, there is probable contaminated vegetation (e.g., grass and trees) and, consequently, the potential for radionuclide transfer to higher levels in the ecological food chain.

In the eventual site characterization and remediation processes, a baseline risk assessment should be conducted. In these pending evaluations, highlighted areas of significance should include:

- Radioactive green-colored aggregate lumps of a uranium compound in an old wood-framed air filter on the ground surface.
- Radioactive yellowish-gray uranyl hydroxide material on the top side of an oblong, concrete structure immediately north and adjacent to Hot Yard Road.
- Buried, 55-gal metal drums (identification of drum contents and drum removal).
- PCBs in soil sampled from a dead-vegetation region north of Hot Yard Road.
- Verification of apparent asbestos material showing elevated beta-gamma activity levels throughout the site.
- Two metal 55-gal drums on the creek bank southeast of Hot Yard Road.
- Numerous small clusters of scrap debris (e.g., pieces of metal and broken glass).
- Off-site migration of radioactive contaminants via a small, ephemeral stream at the west end of WAG 11.

Surficial corrective measures recommended include (1) isolation of contaminated areas (e.g., emplacement of a metal fence with appropriate warning signs) combined with measures to minimize the potential dispersion of radioactivity and (2) removal, treatment (if required), and disposal of contaminated material (e.g., surface debris, soil). A full site characterization including subsurface soil corings and subsequent sample analysis will be necessary to adequately characterize the radiological and hazardous waste status of the White Wing Scrap Yard site and address the most appropriate options for effective, long-term remedial actions.

## 1. INTRODUCTION

A surface radiological investigation of accessible areas at the White Wing Scrap Yard was conducted intermittently from December 1989 through July 1991. This survey was performed by the Measurement Applications and Development Group of the Health and Safety Research Division (HASRD) of the Oak Ridge National Laboratory (ORNL) at the request of Environmental Restoration Program (ERP) personnel at ORNL. The purposes of this survey were (1) to determine the presence, nature, and extent of surface radiological contamination and (2) to recommend interim corrective action to limit human exposures to radioactivity and minimize the potential for contaminant dispersion.

White Wing Scrap Yard has been assigned to Waste Area Group (WAG) 11 by the ORNL ERP staff.<sup>1</sup> Figure 1.1 shows the location of WAG 11 in relation to the other 19 WAGs. It should be noted that the original administrative WAG 11 boundary is an arbitrary boundary based on historical information, aerial flyover radiation surveys, and hydrologically defined units.<sup>1</sup>

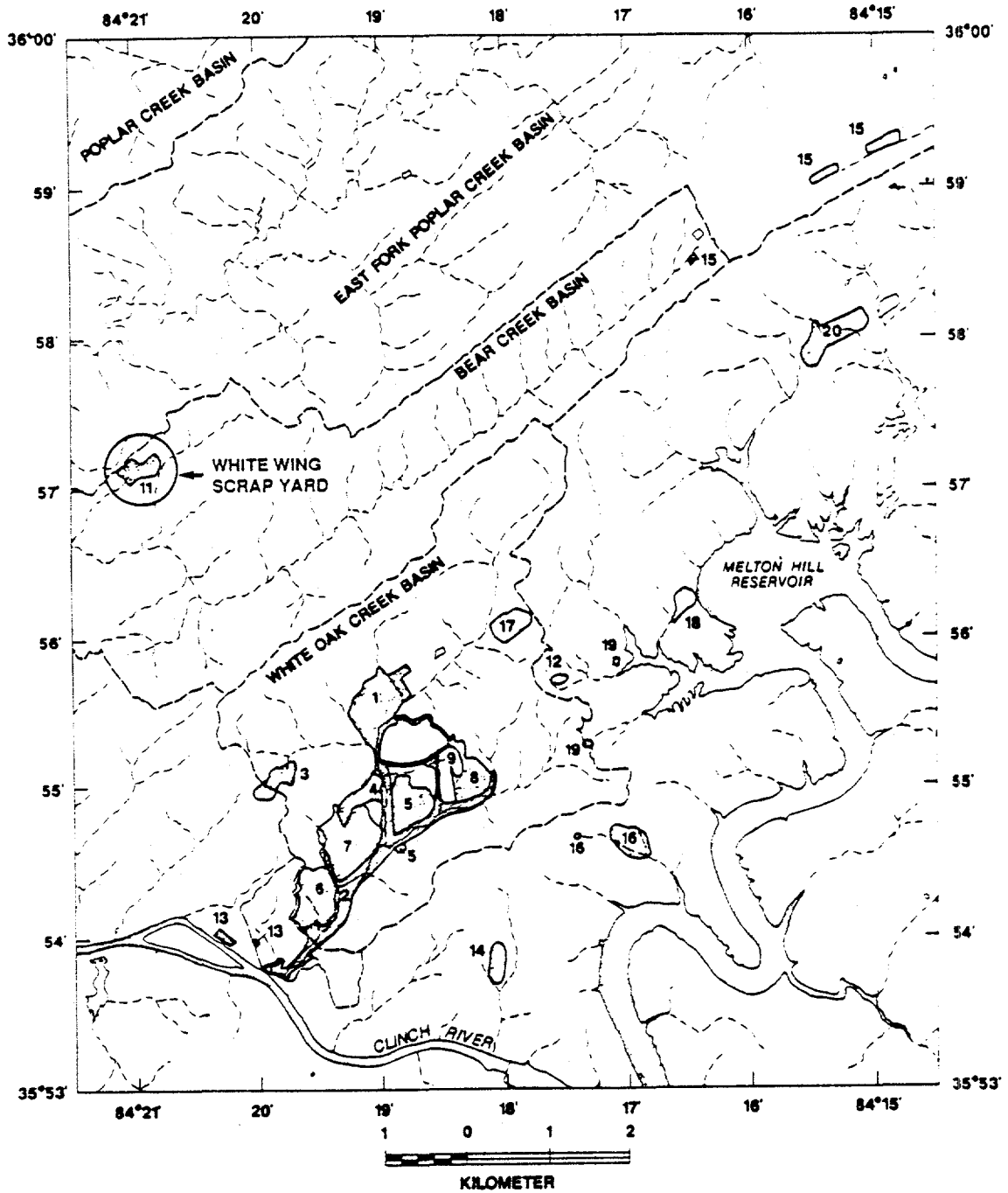


Fig. 1.1. Locations of the 20 Waste Area Groupings (WAGs).

## 2. SITE HISTORY

White Wing Scrap Yard is a largely wooded area of approximately 30 acres located in the McNew Hollow area on the western edge of East Fork Ridge. It is 1 mile east of the junction of White Wing Road (Highway 95) and Oak Ridge Turnpike (Fig. 2.1) and is contained within administrative grid coordinates N34,500 to N35,800 and E27,500 to E29,300.

Approximately 25 of the 30 acres were used for the aboveground storage of contaminated material from the Oak Ridge K-25 Site, the Oak Ridge Y-12 Plant, and ORNL. Reportedly, the area north of Hot Yard Road was used by K-25 and Y-12, and the area south of the road was used by ORNL. Material was first stored at the White Wing Scrap Yard in the early 1950s; however, the precise dates of material storage are uncertain, as is the time when the area was closed to further storage.<sup>2</sup> During active use, the area north of Hot Yard Road was enclosed by a chain-link fence and the area south of the road with a barbed-wire fence. These fences were later removed during surficial site cleanup. The approximate locations of the fenced areas, the WAG 11 boundary, and topographic features of the site are depicted in Fig. 2.2.

In 1966 efforts were begun to clean up the area in preparation for the proposed relocation of White Wing Road. Contaminated scrap materials were removed and buried in ORNL's Solid Waste Storage Area (SWSA) 5. Site cleanup continued into October 1970, when the removal of about 6000 yd<sup>3</sup> of contaminated soil from the southern portion of the site was initiated. It is believed that additional subsurface residual contamination (including the presence of <sup>239</sup>Pu) exists. An aerial view taken prior to scrap removal (March 2, 1967) is shown in Fig. 2.3 and after preliminary cleanup activities (April 19, 1974) in Fig. 2.4.<sup>3</sup>

On November 20, 1974, gamma exposure rates were measured over the scrap yard site during an aerial radiological survey conducted by EG&G. A photograph from that survey, depicting man-made gross-count-rate isopleths at 1 m above the ground surface, is shown in Fig. 2.5. The highest-intensity isopleth included most of the northern area of the scrap yard, confirming that little or no decontamination activities (other than scrap removal) were conducted north of Hot Yard Road. The survey indicated that <sup>137</sup>Cs\* and <sup>234m</sup>Pa\* were the dominant gamma sources present; analysis of the low-energy portion of the spectrum indicated that <sup>234</sup>Th and <sup>235</sup>U were probably also present in the scrap yard.<sup>4</sup>

Currently, most of the area is overgrown with weeds, trees, and other types of vegetation. The amount of material remaining in the region is not known; however, small pieces of broken glass, scrap metal, and plastic appear on the surface over much of the site. On November 10, 1989, the scrap yard was roped and placarded with "Controlled Area" signs at 50-ft intervals and Tennessee Wildlife Resources Agency (TWRA) safety zone signs at 100-ft intervals in order to exclude deer hunters from the site.<sup>1</sup> A planned FY 1991 ERP activity includes installation of a chain-link security fence that will encircle the entire scrap yard. "Radiation Hazard—Keep Out" signs will be posted at specific intervals.<sup>1</sup> Photographs of the site are shown in Figs. 2.6 and 2.7.

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\*Barium-137m, a gamma emitter, is the daughter product of the beta-emitter <sup>137</sup>Cs. Protactinium-234m is a decay product in the uranium decay chain.

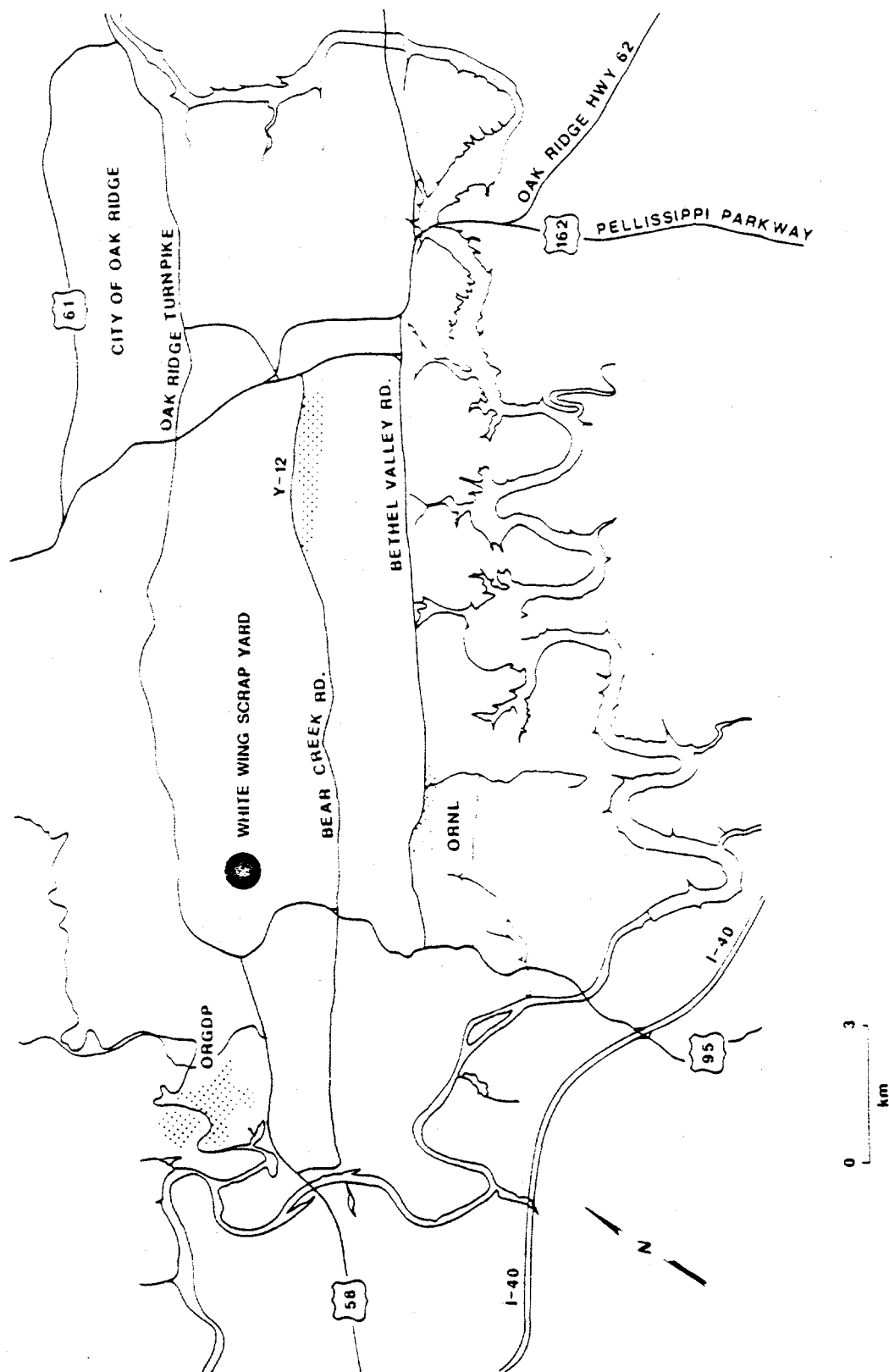


Fig. 2.1. Location of White Wing Scrap Yard (WAG 11).

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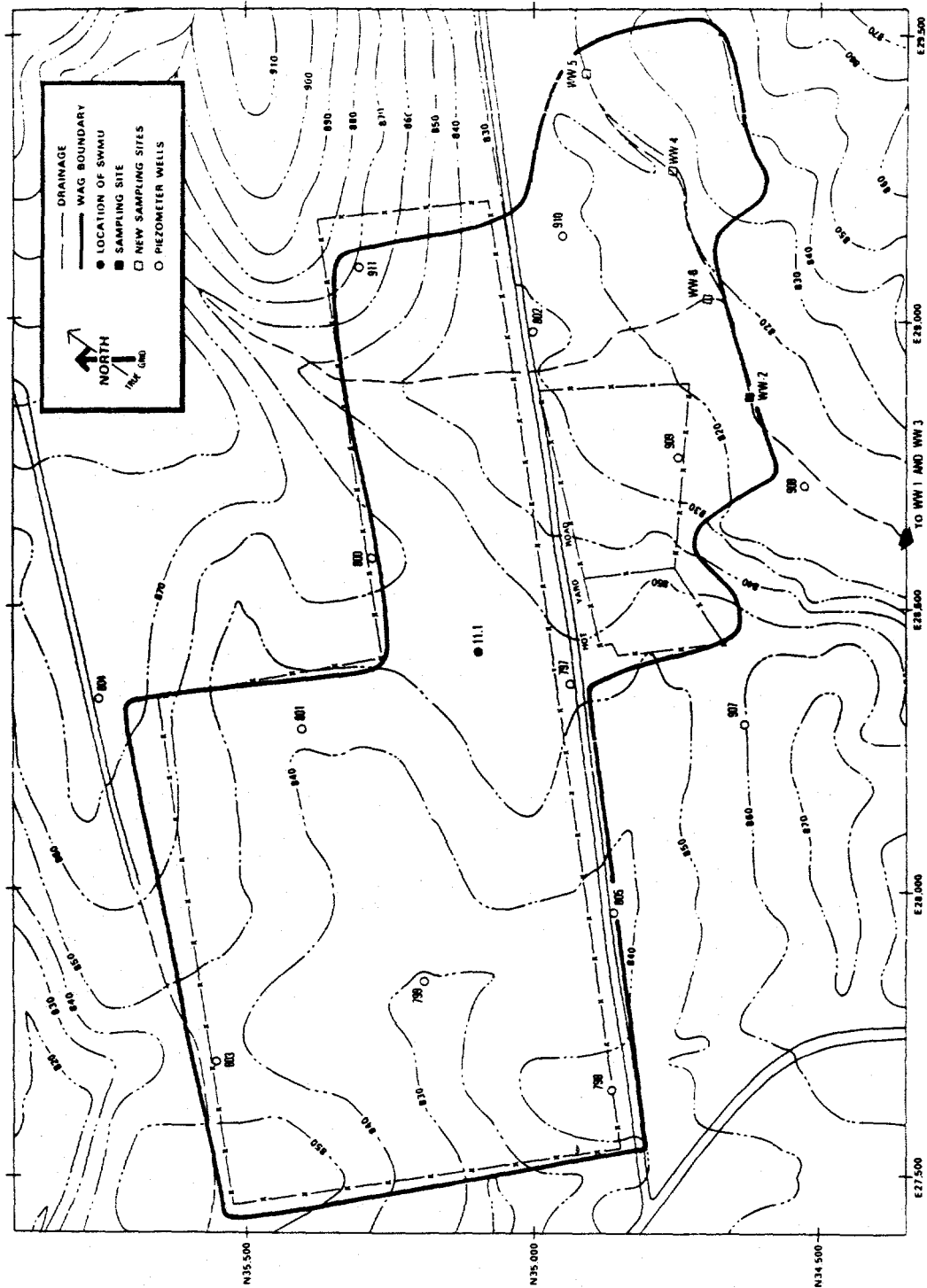


Fig. 2.2. Diagram of White Wing Scrap Yard (WAG 11).

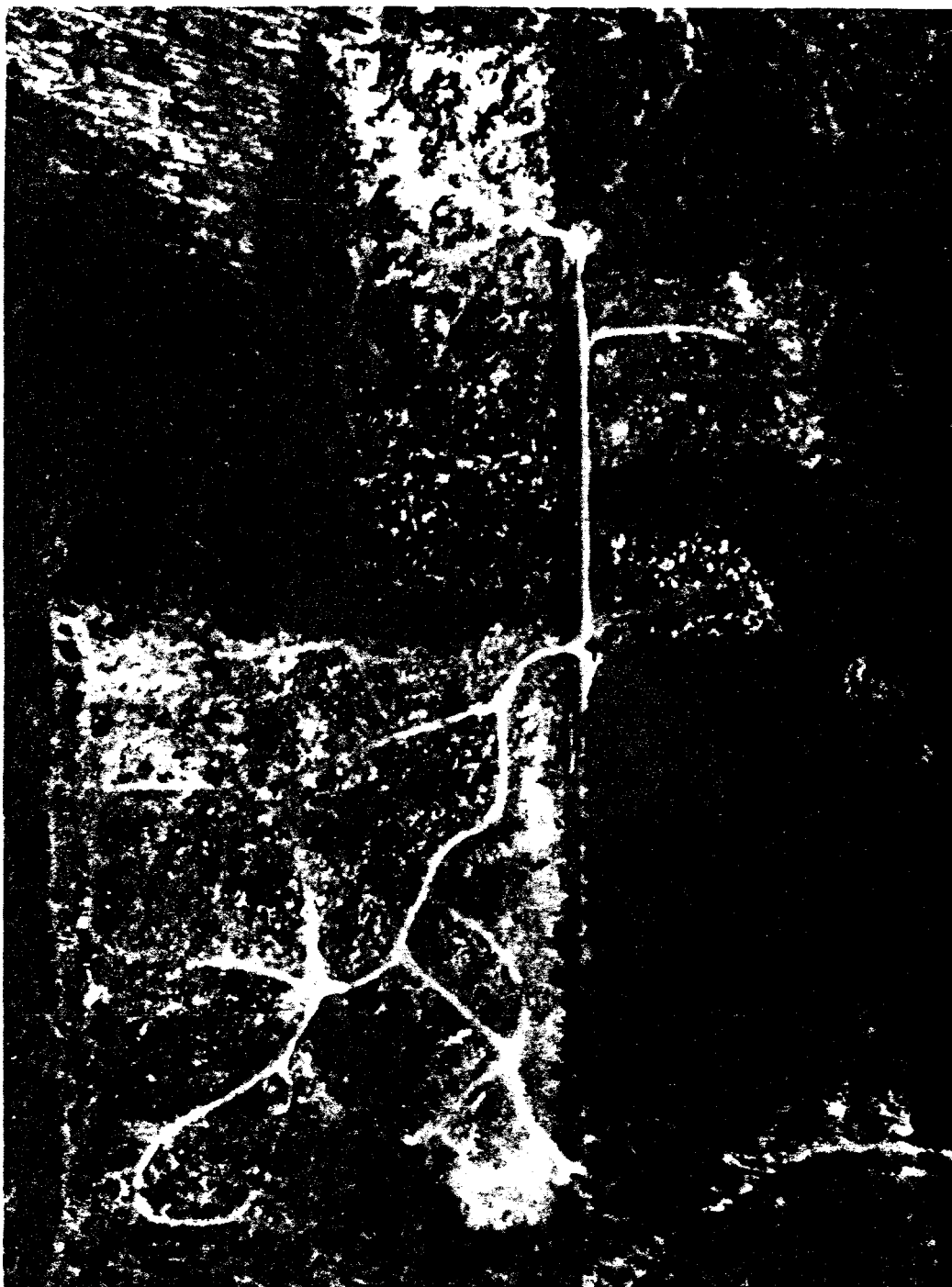


Fig. 2.3. Aerial view of White Wing Scrap Yard prior to surface cleanup (March 1967). Source: W. J. Boegly, Jr., and R. H. Ketelle, Oak Ridge National Laboratory.

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Fig. 2.4. Aerial view of White Wing Scrap Yard after surface cleanup (April 1974). Source: W. J. Boegly, Jr., and R. H. Ketelle, Oak Ridge National Laboratory.

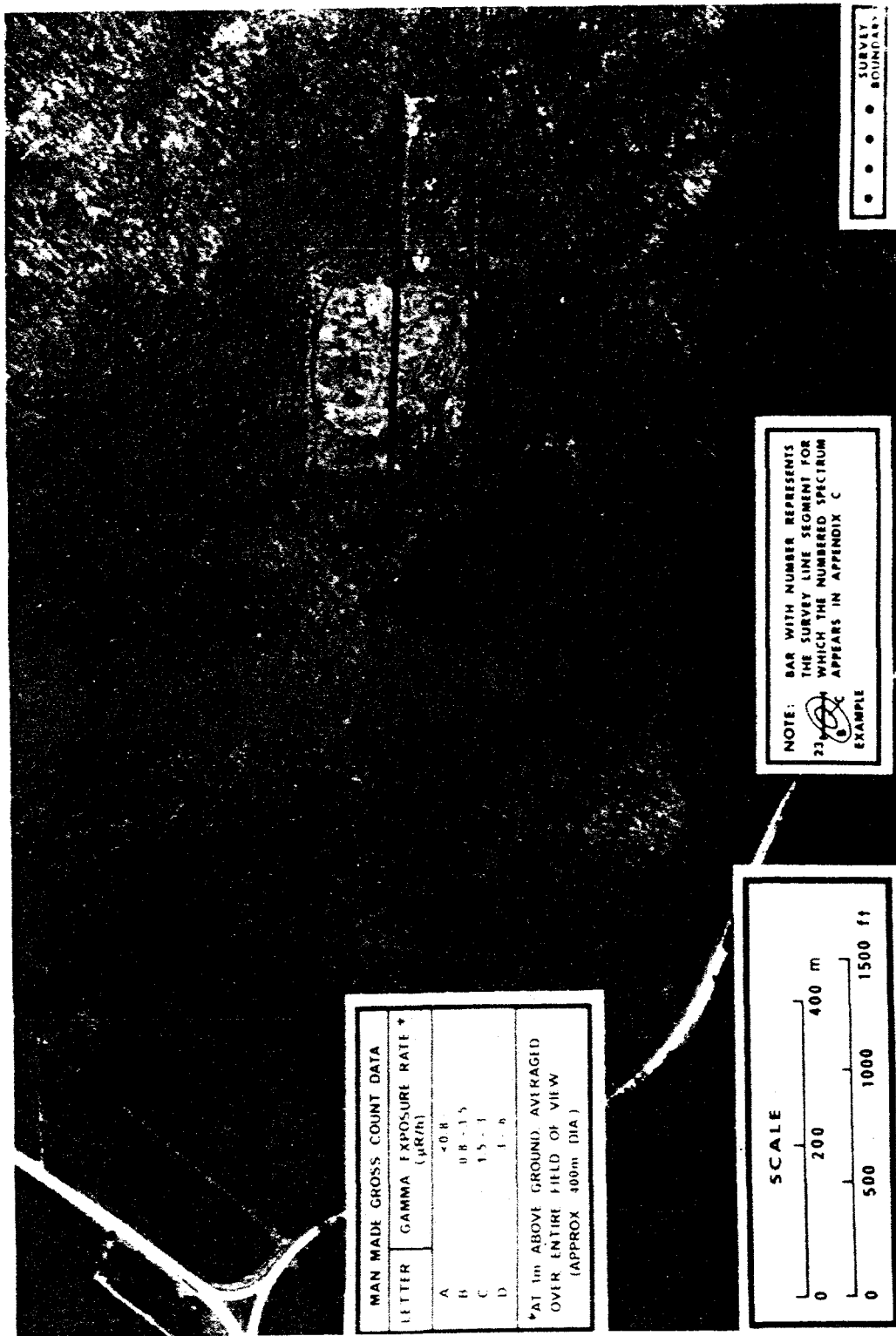


Fig. 2.5. Aerial view of White Wing Scrap Yard showing radiation isopleths (November 1974).  
Source: Z. G. Burson, *Aerial Radiological Surveys of ERDA's Oak Ridge Facilities and Vicinity (Survey Period: 1973-1974)*, EG&G, Inc., Las Vegas Area Operations, EGG-1183-1682 (February 1976).

ORNL-PHOTO 395-90



Fig. 2.6. View of surface debris found north of Hot Yard Road at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 402-90



Fig. 2.7. View looking west at large field where past aboveground storage of contaminated scrap occurred at the White Wing Scrap Yard site (January 1990). Reportedly this area was used by the K-25 Site.

### 3. SURVEY METHODS

A comprehensive description of the methods and instrumentation used in this survey is presented in *Procedures Manual for the ORNL Radiological Survey Activities (RASA) Program*.<sup>5</sup> All direct-measurement results presented in this report are gross readings; background radiation levels have not been subtracted. Similarly, background concentrations have not been subtracted from radionuclide concentrations measured in environmental samples. Selected radioactively contaminated samples (i.e., soil, rocks, and metal debris) were analyzed for uranium by using isotope dilution/mass spectrometry. In addition, gamma spectrometry screening analysis was used to expeditiously identify dominant gamma-emitting radionuclides. Field personnel were checked for alpha and beta-gamma radiation prior to exiting the site.

#### 3.1 GAMMA RADIATION

Gamma radiation was measured with a sodium iodide (NaI) scintillation probe connected to a Victoreen Model 490 Thyac III ratemeter. Because NaI gamma scintillators are energy-dependent, measurements of gamma radiation levels made with these instruments must be normalized to pressurized ionization chamber (PIC) measurements to estimate gamma exposure rates. The function developed for these conversions is

$$y = x \times CF$$

where

$y$  = the exposure rate ( $\mu\text{R/h}$ ),

$x$  = the scintillometer measurements in thousand counts per minute (kcpm),

$CF$  = the slope of the regression line calculated by plotting a selected number of PIC measurements ( $\mu\text{R/h}$ ) vs scintillometer measurements (kcpm) at the same locations.

For this site,  $CF = 1.9$ .

When gamma radiation levels exceeded the limits of the NaI gamma scintillator (800,000 cpm), direct exposure measurements (mR/h) were made with an Eberline Ion Chamber, Model RO-2, and/or a Victoreen Model 450 BRF Ionization Chamber.

#### 3.2 BETA-GAMMA RADIATION

Beta-gamma energy levels were detected with a portable Technical Associates (TA) miniscaler/ratemeter, Model PRS-3, with an HP-260 pancake detector (<2-mg/cm<sup>2</sup> wall thickness). A Bicron miniscaler/ratemeter with a Geiger-Mueller pancake detector was also used to detect beta-gamma radiation. After calibration of the detectors to a known uranium source, beta radiation detection levels in counts per minute were converted to dose rates in millirads per hour using the following relationship:

$$2000 \text{ cpm} = 1 \text{ mrad/h} \quad \text{or} \quad (\text{mrad/h})/\text{cpm} = 0.0005$$

Several highly elevated beta-gamma radiation measurements were taken using a Victoreen Model 450 BRF Ionization Chamber.

### 3.3 ALPHA RADIATION

Alpha radiation was measured with an ORNL alpha survey meter, Model Q-2789-1, connected to a zinc sulfide scintillation probe. Counts per minute were recorded for a direct, 60-s measurement and converted to disintegrations per minute (dpm) per 100 cm<sup>2</sup> using the instrument-specific conversion factor. During some portions of the survey period, alpha and beta-gamma measurements were taken under wet conditions. Wet or moist conditions can somewhat attenuate the amount of detectable beta radiation and completely attenuate alpha radiation detection.

### 3.4 GRID

For convenience in reporting results, the White Wing Scrap Yard site was divided into 100-ft grid blocks as shown in Fig. 3.1. The grid blocks are identified by the intersection of two perpendicular lines. The first coordinate identifies 100-ft distances from point 0 plus two digits representing additional number of feet (e.g., 1+00 = 100 ft or 9+35 = 935 ft). The second coordinate is derived from distance to the right or left of the baseline (BL) (e.g., 100 ft to the right = 100R). An individual grid block is identified by the coordinates of its upper left corner (see Grid Block ID legend on Fig. 3.1). Grid points 0+00 through 17+00 were established during an engineering survey; corresponding Y-12 master grid system coordinates (measured in feet) are given in Appendix A, Table A.1. Grid points -1+00 through -4+00 are estimated positions established to approximate locations west of the WAG 11 boundary.

### 3.5 SCOPE OF THE SURVEY

The survey included:

- Gamma exposure rate measurements at 1 m above the ground surface and at the surface at accessible grid points.
- A surface gamma scan of accessible land areas, including Hot Yard Road, the area extending 10 to 20 ft outside the perimeter of the rope boundary, a creek adjoining the southeast WAG boundary, and a wet-weather stream located at the west end of the site. Accessible parts of the areas shaded in Fig. 3.1 were surveyed; up to 90% of some grid blocks were inaccessible. The NaI scintillation probe held approximately 2 in. above the ground surface was used to detect gamma radiation. The gamma scan of Hot Yard Road was conducted prior to the recent addition of gravel material (Fig. 3.2).
- Beta-gamma and alpha spot-check measurements of selected scrap material.
- Isotope dilution/mass spectrometry analysis and gamma spectrometry screening of selected samples.
- Radionuclide analysis of selected soil samples and one water sample.
- Chemical analysis for volatile organics, semivolatile organics, herbicides, and polychlorinated biphenyls (PCBs) in selected soil samples.

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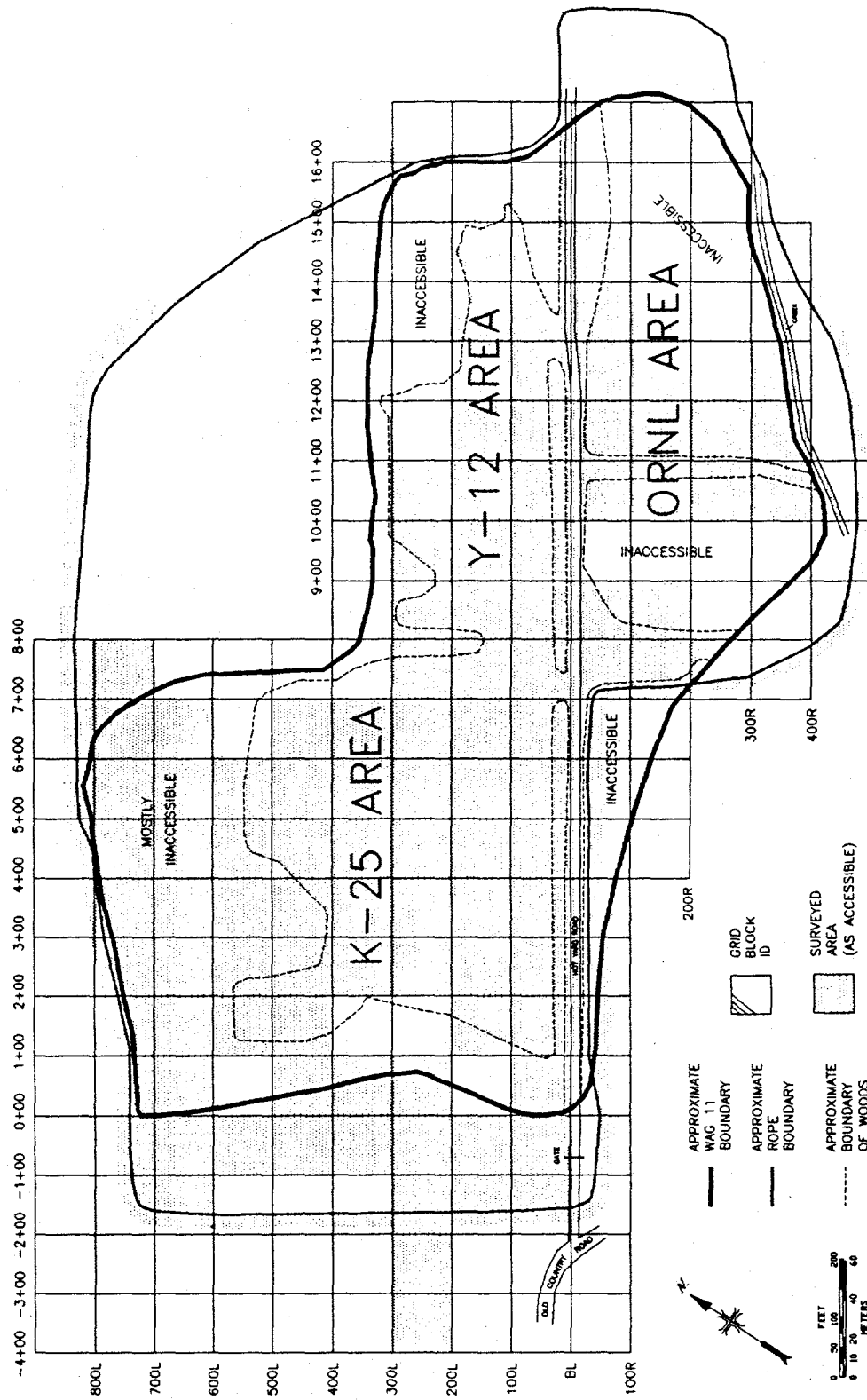


Fig. 3.1. Diagram showing grid block locations at the White Wing Scrap Yard site. Reportedly, the area north of Hot Yard Road was used by K-25 and Y-12, and the area south of the road was used by ORNL. Only accessible areas of the shaded grid blocks were surveyed.

ORNL-PHOTO 385-90



Fig. 3.2. View looking east at Hot Yard Road at the White Wing Scrap Yard site (January 1990).

## 4. SURVEY RESULTS

### 4.1 BACKGROUND LEVELS

Background gamma exposure rates measured at uncontaminated outdoor areas on the Oak Ridge Reservation are listed in Table 4.1. Eighteen measurements taken at nine locations ranged from 8 to 13  $\mu\text{R/h}$  (average 10  $\mu\text{R/h}$ ) at 1 m above the ground surface and from 10 to 17  $\mu\text{R/h}$  (average 13  $\mu\text{R/h}$ ) at the surface. Measurements from selected grid points at the White Wing Scrap Yard site are listed in Table 4.2. Fifty-six grid point measurements ranged from 11 to 42  $\mu\text{R/h}$  (average 17  $\mu\text{R/h}$ ) at 1 m and from 8 to 48  $\mu\text{R/h}$  (average 18  $\mu\text{R/h}$ ) at the surface.

### 4.2 SURFACE GAMMA AND BETA-GAMMA MEASUREMENTS

Results of the surface gamma and beta-gamma scanning measurements of accessible areas at the White Wing Scrap Yard are shown in Fig. 4.1. In most areas, the hot spots (depicted by dots) are accurately located in Fig. 4.1, but in areas with numerous hot spots, the dots only approximate actual locations and numbers. Several acres of land were inaccessible to surface scanning because of the overgrowth of trees and understory vegetation such as shrubs, weeds, and vines.

In general, surface radioactivity was detected as small, localized hot spots and larger, contaminated soil regions. Because selected beta-gamma measurements were taken concurrently with elevated gamma radiation measurements, these data will be reported en masse. For the purposes of reporting, the WAG 11 site is categorized into six distinct "areas." These areas are based on the regional clustering of surface radioactivity and land features as depicted in Fig. 4.1. They are as follows: (1) Center of WAG 11 (North of Hot Yard Road); (2) Northwest area of WAG 11; (3) Northwest area of WAG 11 (outside of the WAG 11 boundary); (4) Northeast area of WAG 11 (north of Hot Yard Road); (5) Area south of Hot Yard Road; and (6) Roads. Survey findings of these areas are summarized below.

#### *Center of WAG 11 (North of Hot Yard Road)*

- The results of gamma scanning demonstrate the presence of localized, well-defined hot spots and contaminated land regions. Generally, this area exhibited the most numerous concentration of surface hot spots and land regions. Grid block location 6+00, 400L was determined to be the most contaminated grid block. Localized surface hot spots showed gamma radiation exposure rates of 2.5 mR/h (6+75, 333L), 3.0 mR/h (6+66, 326L), and 0.8 mR/h (6+66, 303L).

Table 4.1. Radiation levels measured in uncontaminated areas on the Oak Ridge Reservation

Type of radiation <sup>a</sup>	Radiation level ( $\mu$ R/h)	
	Range	Average
Gamma exposure rate at 1 m above ground surface	8-13	10
Gamma exposure rate at ground surface	10-17	13

<sup>a</sup>Values were obtained from 18 measurements taken from nine locations on the Oak Ridge Reservation.

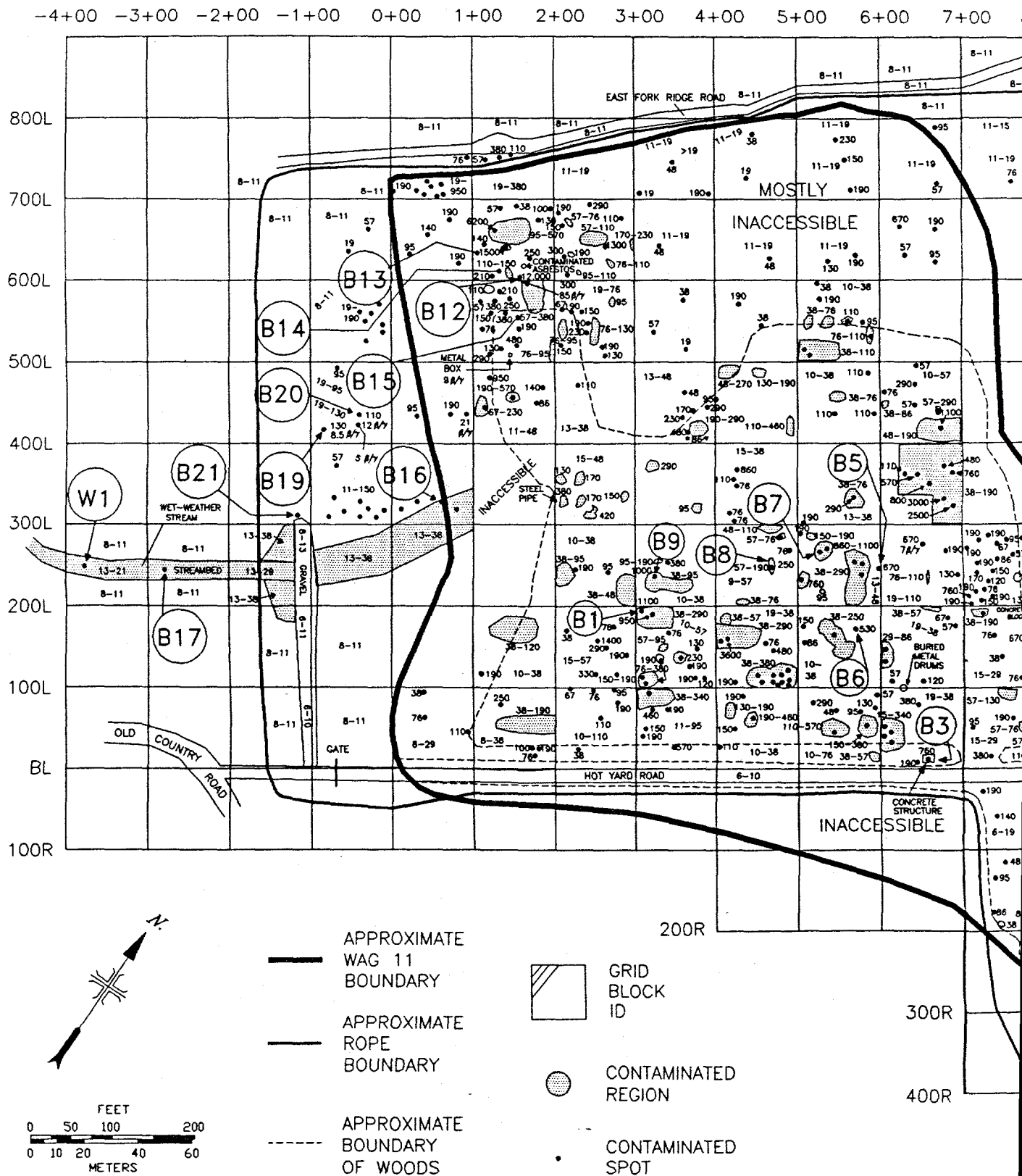
Table 4.2. Gamma exposure rate measurements at selected grid points at the White Wing Scrap Yard site

Grid point <sup>a</sup>	Location <sup>b</sup>		Gamma exposure rate ( $\mu$ R/h)	
	North	East	1 m above ground surface	Surface
0+00, 100L	34,932	27,652	11	10
1+00, 100L	34,946	27,751	12	10
1+00, 200L	35,045	27,737	13	15
1+00, 500L	35,342	27,695	13	10
1+00, 600L	35,441	27,682	11	11
1+00, 700L	35,540	27,668	19	19
2+00, 100L	34,960	27,850	19	13
2+00, 200L	35,059	27,836	17	15
2+00, 300L	35,158	27,882	32	32
2+00, 400L	35,257	27,808	15	14
2+00, 500L	35,356	27,795	38	48
2+00, 600L	35,455	27,781	27	27
2+00, 700L	35,554	27,767	11	12
3+00, 100L	34,973	27,949	42	46
3+00, 200L	35,072	27,935	32	30
3+00, 300L	35,172	27,921	19	23
3+00, 400L	35,271	27,907	15	15
3+00, 500L	35,370	27,894	23	27
4+00, 100L	34,987	28,048	23	29
4+00, 200L	35,086	28,034	19	29
4+00, 300L	35,185	28,020	15	19
4+00, 400L	35,284	28,006	14	12
4+00, 500L	35,383	27,993	23	30
5+00, 100L	35,001	28,147	17	19
5+00, 200L	35,100	28,133	17	19
5+00, 300L	35,199	28,119	25	29
5+00, 600L	35,496	28,078	19	19
6+00, 100L	35,015	28,246	34	23
6+00, 200L	35,114	28,232	23	19
6+00, 300L	35,213	28,218	13	11
6+00, 400L	35,312	28,205	30	38
6+00, 500L	35,411	28,191	34	38

Table 4.2 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>		Gamma exposure rate ( $\mu\text{R/h}$ )	
	North	East	1 m above ground surface	Surface
7+00, BL	34,930	28,359	8	8
7+00, 100L	35,029	28,345	10	10
7+00, 200L	35,128	28,331	23	19
7+00, 300L	35,227	28,317	29	27
7+00, 100R	34,831	28,373	9	9
7+00, 200R	34,732	28,386	9	10
8+00, BL	34,943	28,458	9	8
8+00, 100L	35,042	28,444	11	12
8+00, 200L	35,141	28,430	13	13
8+00, 300L	35,241	28,416	11	10
8+00, 100R	34,844	28,472	10	10
9+00, 100L	35,056	28,543	12	10
9+00, 200L	35,155	28,529	11	13
9+00, 300L	35,254	28,515	19	14
10+00, 100L	35,070	28,642	10	11
10+00, 200L	35,169	28,628	13	12
10+00, 300L	35,268	28,614	11	10
10+00, 200R	34,773	28,683	10	10
11+00, 100L	35,084	28,741	11	12
11+00, 200L	35,183	28,777	15	17
11+00, 200R	34,787	28,783	9	9
12+00, 100L	35,098	28,840	11	11
12+00, 200L	35,197	28,826	9	10
13+00, 200L	35,210	28,925	10	12

<sup>a</sup>Grid blocks are shown on Fig. 3.1.<sup>b</sup>Y-12 grid coordinates measured in feet.



**Fig. 4.1. Regions of elevated surface gamma exposure rates ( $\mu\text{R/h}$ ), beta-gamma dose rates ( $\beta/\text{y}$ ) Scrap Yard site. Soil and water sampling locations are designated with B# and W#. Locations and numbers accessible areas of the site; wooded areas were generally inaccessible. Inaccessible areas within surveyed grid t**



- Radioactive, green-colored aggregate lumps of material located north of Hot Yard Road (grid location 7+79, 177L) were found in what appears to be an old wood-framed air filter lying on the ground surface. Measurements on contact with a plastic bag containing a sample of this material showed gamma exposure rates of up to 2.5 mR/h; beta-gamma dose rates measured 7 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~40% by weight (probable composition, a mixture of uranium fluoride and uranium oxide compounds; sample B2).
- On the top side of a large, oblong concrete structure immediately north of and adjacent to Hot Yard Road (grid location 6+44, 20L), a coarse, yellowish-gray material was found to be radioactive. Gamma radiation measurements on contact with a plastic bag containing a sample of this material showed exposure rates of up to 5 mR/h; beta-gamma dose rates measured 15 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~80% by weight (composition, uranyl hydroxide; sample B3).
- Beta-gamma spot-check measurements of selected debris on the ground surface included elevated dose rates of up to 7.5 mrad/h on contact with the interior of an old metal air duct (grid location 7+77, 237L).

#### *Northwest area of WAG 11*

- The results of gamma scanning demonstrate the presence of numerous localized, well-defined hot spots and contaminated land regions. Grid block location 1+00, 700L was determined to be the most contaminated grid block. Three localized surface hot spots with gamma exposures rates of 12 mR/h (85 mrad/h beta-gamma), 6.2 mR/h, and 1.5 mR/h were found (see Fig. 4.1). Gamma spectroscopy screening analysis of sample B12 from this area demonstrated the presence of  $^{137}\text{Cs}$ . This is a region of dead vegetation located at the former K-25 scrapping operations area. Special items of interest include localized pockets of sharp pieces of metal and broken glass on the ground surface.
- A small, sealed gray metal box showing contact beta-gamma dose rates of 9 mrad/h was found in grid block 1+00, 600L. "Determined to be Cadmium" was inscribed on the exterior of the box. After the box was carefully opened, interior measurements showed very low levels of radioactivity. Gamma spectrometry screening analysis of a smear sample collected from the exterior surface identified  $^{238}\text{U}$  as the primary contaminant.
- In grid block -1+00, 500L, a region of surface contamination contained a myriad of contaminated debris including metal, plastic, and glassware (including a broken glass syringe). Several spots with elevated gamma exposure rates were investigated and found to be caused by buried, contaminated metal pieces; other spots were due to residual soil contamination. In this region, gamma exposure rates ranged from 10 to

190  $\mu\text{R/h}$ , and beta-gamma dose rates ranged up to 21 mrad/h on contact with pieces of scrap metal. Dense brush covered most of the area, preventing a thorough survey. Two soil samples, B19 and B20, collected in this region show  $^{137}\text{Cs}$  and  $^{238}\text{U}$  as the primary contaminants.

*Northwest area of WAG 11 (outside of the WAG 11 boundary)*

- Near-surface gamma exposure rates ranging from 13 to 29  $\mu\text{R/h}$  (outside the WAG 11 rope boundary) follow an ephemeral, wet-weather stream with contiguous contamination extending west beneath Old Country Road. A streambed soil sample (B17) was collected ~120 ft outside the west rope boundary. Analytical results demonstrate  $^{238}\text{U}$  concentrations of 100 pCi/g in this sample.
- Special items of interest include (1) a contaminated piece of ceramic material (washer-shaped) was found in grid block -1+00, 500L (gamma spectroscopy analysis estimates ~0.3  $\mu\text{Ci}$  gross activity; sample B20B); (2) a slag brick (sample B21), found in the grid block -2+00, 400L, showed ~0.2  $\mu\text{Ci}$  gross activity [10 mrad/h (beta-gamma) on contact]; and (3) at grid block location 1+00, 800L, surface hot spots with gamma exposure rates ranging from 57 to 380  $\mu\text{R/h}$  (Fig. 4.2) were measured outside the rope boundary and adjacent to the road.

*Northeast area of WAG 11 (north of Hot Yard Road)*

- The results of gamma scanning show primarily surface hot spot contamination with contaminated pieces of metal. Grid block location 14+00, 100L was determined to be the most contaminated grid block. Localized, surface hot spots with gamma exposure rates of up to 190  $\mu\text{R/h}$  were found.
- A large area with gamma exposure rate levels of up to 144  $\mu\text{R/h}$  was found in grid block 15+00, 300L. Spotty contamination extended from this area southward to Hot Yard Road.
- Grid block 15+00, 100L contained a pile of graphite blocks that appeared to cover an area of contamination.
- Grid block 13+00, 100L was littered with slightly contaminated (~0.5 mrad/h) metal and apparent asbestos material. Gamma exposure rates ranged from 15 to 50  $\mu\text{R/h}$  at the ground surface.
- Grid block 14+00, 200L contained contaminated debris with gamma exposure rates ranging from 12 to 150  $\mu\text{R/h}$ .

ORNL-PHOTO 7051-91

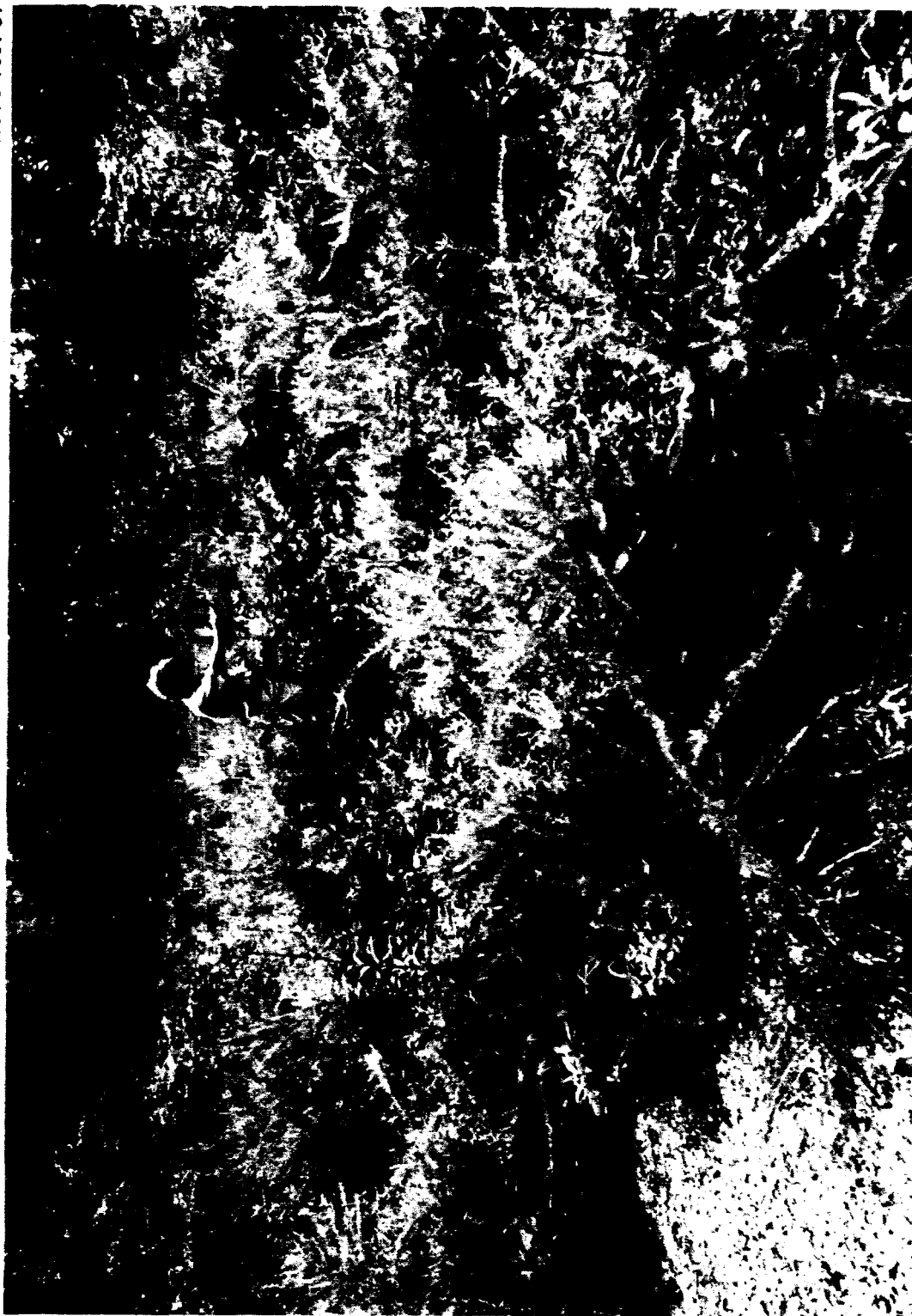


Fig. 4.2. View looking south from East Fork Ridge Road at area with hot spots up to 380  $\mu\text{R/h}$  located outside the WAG 11 rope boundary (July 1991).

### ***Area South of Hot Yard Road***

- A region of contamination beginning in block 10+00, BL continues southward at least 400 ft through block 10+00, 300R. The region contains areas of generally elevated gamma exposure rates, many scattered gamma and beta-gamma point sources, and much scrap material, some of which is contaminated. In block 10+00, BL near the gravel road, a contaminated metal rod ( $\sim 18 \times 3/16$  in.) exhibited gamma exposure rates of 200  $\mu\text{R/h}$  and beta-gamma dose rates of 26 mrad/h.
- In grid block 10+00, 100R, contaminated material includes pieces of apparent asbestos-containing board and cloth with beta-gamma dose rates reaching 1.5 mrad/h. Newly accessible areas of block 10+00, 200R revealed a partially buried piece of lead ( $\sim 1/2$  in. thick) with slightly elevated beta-gamma dose rates (0.1 mrad/h) located beside the road.
- Grid block 11+00, BL contains numerous spots with surface gamma exposure rates ranging from 60 to 400  $\mu\text{R/h}$  and several pieces of contaminated scrap material (mostly metal) with beta-gamma dose rates ranging up to 18 mrad/h. On the eastern side of this block, a large anomalous region with surface gamma exposure rates ranging from 19 to 860  $\mu\text{R/h}$  and beta-gamma dose rates ranging from 0.05 to 8.5 mrad/h extends into block 12+00, BL.
- In grid block 12+00, BL, a hot spot measuring 22 mrad/h and 530  $\mu\text{R/h}$  was detected. A soil sample taken from this spot (B18) demonstrates the presence of  $^{238}\text{U}$ .
- In grid block 11+00, 100R: (1) a piece of ceramic material showed beta-gamma dose rates of 5.6 mrad/h at 6 in. (direct-contact measurements were off-scale of the instrument), directly measured alpha activity of 1000 dpm/100  $\text{cm}^2$ , and transferable alpha activity of 49 dpm/100  $\text{cm}^2$ ; and (2) elevated surface gamma exposure rates ranged from 13 to 760  $\mu\text{R/h}$  in accessible portions of the grid block ( $\sim 20\%$  of the block is only partially accessible). Several pieces of contaminated scrap material are located in this block.
- Beta-gamma dose rates reached 8 mrad/h on contact with the interior surface of four to five metal drums (aboveground at grid location 9+60, 320R). The drums were empty and showed substantial corrosion.

### ***Roads***

- Surface gamma exposure rate measurements along Hot Yard Road (6 to 13  $\mu\text{R/h}$ ) indicate typical background radiation levels (Fig. 4.1).
- Surface gamma exposure rates along the East Fork Ridge Road north of the WAG 11 boundary show generally 8 to 11  $\mu\text{R/h}$ . Several hot spots ranging from 56 to 380  $\mu\text{R/h}$  were identified near the road in grid blocks 0+00, 800L and 1+00, 800L (see Fig. 4.2).

- Surface gamma scanning indicates that residual radiological contamination is present beneath a gravel road that provides access to a water quality well [well number 1139, E28,701 (ft)/N34,508 (ft)]. The access road adjoins Hot Yard Road at grid location 10+00, BL. Contaminated surface regions were identified adjacent to the gravel road, and several discrete spots of slightly elevated gamma exposure rates were found on the road surface.

#### 4.3 SAMPLE ANALYSES

Results of sample analysis show  $^{238}\text{U}$  and  $^{137}\text{Cs}$  to be the dominant radiological contaminants. The locations of sampling sites are shown in Fig. 4.1. The results of isotopic dilution/mass spectrometry of four samples (B1A, B1B, B4, and B5) show elevated concentrations of uranium enriched in the isotope  $^{235}\text{U}$  (see Table 4.3). The degree of enrichment was as high as 15 atomic percent  $^{235}\text{U}$  in sample B4. The concentration of total uranium was 0.22 g of uranium per gram of analyzed sample (B4). It should be noted that samples B1A and B1B appeared to be a soil/concrete/rock mixture, whereas B4 and B5 samples consisted of a fused slag/rock/metal matrix.

Isotope dilution/mass spectrometry analysis results of sample B2 (green material) and sample B3 (yellowish-gray material) showed total uranium concentrations comprising ~40% and ~80% by weight, respectively, of the analyzed sample. X-ray diffraction spectra indicated that sample B2 was a probable mixture of uranium fluoride and uranium oxide compounds. Sample B3 was identified as uranyl hydroxide [ $\text{UO}_2(\text{OH})_2$ ].

Levels of the  $^{235}\text{U}$  isotope in samples B2 (0.67 atomic percent) and B3 (0.66 atomic percent) indicate a slight depletion ( $^{235}\text{U} < 0.7\%$ ) of this isotope compared with the natural relative abundance of uranium isotopes. Most likely, these samples are depleted by-products of uranium isotope separation (a step in the isotope enrichment process).

Five samples contained  $^{236}\text{U}$  with isotopic abundances ranging from 0.0064% to 0.043%. The presence of  $^{236}\text{U}$  indicates that the uranium contamination found on this site originated with reprocessed reactor fuel.

Gamma spectrometry screening analysis of 12 environmental samples (see Table 4.4) indicate the presence of  $^{238}\text{U}$ ,  $^{235}\text{U}$ , and  $^{137}\text{Cs}$  at concentrations up to 30,000 pCi/g, 490 pCi/g, and 21,000 pCi/g, respectively. In sample B6A, estimated total  $^{238}\text{U}$  activity is 1,200,000 pCi and estimated total  $^{235}\text{U}$  activity is 140,000 pCi, whereas sample B9 demonstrates total activities of 2,300,000 pCi of  $^{238}\text{U}$  and 94,000 pCi of  $^{235}\text{U}$ . (Estimated total weights of these concrete/rock samples are ~500 g for sample B6A and ~3 kg for sample B9.) In addition, samples B18, B19A, B19B, and B20 demonstrate the presence of  $^{238}\text{U}$ . None of the three samples collected south of Hot Yard Road (B10, B11, and B18) were analyzed for the presence of plutonium.

Table 4.3. Contribution of  $^{234}\text{U}$ ,  $^{235}\text{U}$ ,  $^{236}\text{U}$ , and  $^{238}\text{U}$  toward total uranium content in samples from the White Wing Scrap Yard site

Sample ID	Sample location <sup>c</sup>	Isotopic abundance (atomic percent) <sup>a,b</sup>			
		$^{234}\text{U}$	$^{235}\text{U}$	$^{236}\text{U}$	$^{238}\text{U}$
B1A	3+11, 200L	0.029 ± 0.001	4.669 ± 0.013	0.043 ± 0.001	95.259 ± 0.013
B1B	3+11, 200L	0.024 ± 0.001	4.570 ± 0.011	0.042 ± 0.001	95.364 ± 0.011
B2	7+79, 177L	0.0049 ± 0.0004	0.6766 ± 0.0038	0.0064 ± 0.0006	99.312 ± 0.004
B3	6+44, 20L	0.0040 ± 0.0004	0.6656 ± 0.003	0.0071 ± 0.0004	99.323 ± 0.0034
B4	12+40, 160L	0.15 ± 0.01	15.75 ± 0.15	<i>d</i>	84.10 ± 0.36
B5	5+95, 238L	0.022 ± 0.001	3.474 ± 0.009	0.029 ± 0.001	96.475 ± 0.010

<sup>a</sup>Isotopic dilution/mass spectrometry analysis performed by the Analytical Chemistry Division, ORNL.

<sup>b</sup>Analytical error of measurement is less than the 95% confidence level.

<sup>c</sup>Sample locations are shown on Fig. 4.1.

<sup>d</sup>No analysis conducted.

Table 4.4. Concentrations of  $^{137}\text{Cs}$ ,  $^{226}\text{Ra}$ ,  $^{232}\text{Th}$ ,  $^{238}\text{U}$ , and  $^{235}\text{U}$  in environmental samples collected from the White Wing Scrap Yard site

Sample ID	Sample location <sup>a</sup>	Radionuclide concentration (pCi/g)				
		$^{137}\text{Cs}$	$^{226}\text{Ra}$	$^{232}\text{Th}$	$^{238}\text{U}$	$^{235}\text{U}$
B6A	5+76, 176L	b	b	b	$1,200,000 \pm 4^c$	$140,000 \pm 2^c$
B6B	5+76, 176L	$29 \pm 0.6$	$1.4 \pm 0.2$	$1.3 \pm 0.3$	$780 \pm 20$	$200 \pm 3$
B9	3+41, 218L	b	b	b	$2,300,000 \pm 3^c$	$94,000 \pm 2^c$
B12	1+70, 606L	$21,000 \pm 20$	$<5.4$	$<8.3$	$230 \pm 50$	$13 \pm 10$
B16	0+60, 340L	$4.10 \pm 0.2$	$1.6 \pm 0.1$	$1.4 \pm 0.2$	$435 \pm 10$	$23 \pm 0.7$
B17	-3+30, 250L	$1.1 \pm 0.05$	$1.4 \pm 0.06$	$1.2 \pm 0.09$	$100 \pm 4$	$6.8 \pm 0.3$
B18	12+70, 58R	$0.94 \pm 0.8$	$<10.0$	$<5.0$	$30,000 \pm 200$	$360 \pm 6$
B19A	-1+10, 410L	$480 \pm 4$	$7.4 \pm 1$	$1.6 \pm 1$	$2,400 \pm 30$	$110 \pm 5$
B19B	-1+10, 410L	$240 \pm 2$	$4.7 \pm 0.6$	$1.4 \pm 0.5$	$1,300 \pm 30$	$61 \pm 3$
B20A	-1+60, 430L	$18 \pm 0.9$	$1.4 \pm 1$	$<3.0$	$15,000 \pm 50$	$490 \pm 7$
B20B	-1+60, 430L	b	b	b	$300,000 \pm 10^c$	$4,700 \pm 20^c$
B21	-2+85, 315L	b	b	b	$140,000 \pm 10^c$	$4,800 \pm 10^c$

<sup>a</sup>Sample locations are shown on Fig. 4.1.

<sup>b</sup>Not measured.

<sup>c</sup>Estimated total sample activity in picocuries determined by preliminary gamma spectroscopy.

Analytical results (Appendix A, Table A.2) of soil samples B13, B14, and B15 collected from a region of dead vegetation at the former K-25 scrapping operations area demonstrate the presence of PCB contamination. Each sample contained ~10 ppm total PCBs (the primary contributor being Aroclor 1254). Biphenyl compounds identified by semivolatile organic analysis (see Appendix A, Table A.3) further confirmed the presence of PCBs. Because of the presence of PCBs and elevated gross alpha and gross beta concentrations (see Table 4.5) in split soil samples collected from this dead-vegetation region, this location should be further investigated as a possible mixed-waste area.

Results of analysis for 34 volatile organic compounds and 65 base/neutral/acid extractable organics in soil samples B13, B14, and B15 show that only three compounds were measured at concentrations above quantitation limits (Appendix A, Tables A.4 and A.5). Two volatile organic compounds, methylene chloride and acetone, and one semivolatile, bis(2-ethylhexyl)phthalate, were detected at levels above their respective quantitation limits. The types and low concentrations of these organics indicate common laboratory contaminants.

**Table 4.5. Concentrations of  $^{60}\text{Co}$ ,  $^{137}\text{Cs}$ , gross alpha, gross beta, and  $^{40}\text{K}$  in soil and water samples collected at the White Wing Scrap Yard site**

Sample ID	Location <sup>a</sup>	Concentration (pCi/g or pCi/L)				
		<sup>60</sup> Co	<sup>137</sup> Cs	Gross alpha	Gross beta	<sup>40</sup> K
Soil samples (pCi/g)						
B13	1+13, 647L	<i>b</i>	1.2 ± 0.03	200 ± 30	320 ± 30	0.70 ± 0.2
B14	1+39, 622L	<i>b</i>	27 ± 0.5	320 ± 50	490 ± 30	6.5 ± 1.6
B15	1+50, 567L	<i>b</i>	24 ± 0.5	860 ± 50	1300 ± 50	6.2 ± 1.9
Water sample (pCi/L)						
W1	-4+30, 250L	4 ± 9	0.27 ± 6	12 ± 6	23 ± 8	<i>b</i>

<sup>a</sup>Sample locations are shown on Fig. 4.1.

<sup>b</sup>Not measured.

## 5. SIGNIFICANCE OF FINDINGS

The surface radiological survey of accessible land areas at the White Wing Scrap Yard revealed numerous localized clusters of hot spots and larger regions of contaminated land exhibiting elevated surface gamma exposure rates. The presence of residual contamination in soil and radioactively contaminated debris on the ground surface and in the soil matrix demonstrates that previous cleanup operations (i.e., scrap removal) were insufficient. The extensive dispersion of contamination probably resulted from several past activities, including the storage of contaminated materials (e.g., metal, glass, concrete, and miscellaneous industrial trash), removal of scrap materials, and preliminary cleanup activities. Although cleanup activities and remediation of localized areas of contaminated soil have reportedly occurred, these survey results show that current radiological conditions at the site remain a complex environmental problem and a potential risk to human health. (It should be noted that several corrective action measures have been taken as a result of the preliminary findings of this investigation).

Subsequent to preliminary survey findings in 1990, heavy brush that generally limited and selectively prohibited survey scanning south of Hot Yard Road was moderately cleared, providing greater survey access. However, many areas throughout the WAG were generally inaccessible and only limited spot-checks for surface radioactivity could be made. Additionally, as a result of expanding the surface survey to include areas beyond the original survey grid, portions of the WAG were not gridded. Grid point designations of -1+00 represent merely estimates of location. In general, most of the radiation measurement results are depicted in Fig. 4.1. Nevertheless, one should not preclude the presence of subsurface radiological contamination in areas devoid of detectable surface radioactivity.

The following is a synopsis of significant survey findings, categorized by waste type and/or uniqueness, that were identified at the White Wing Scrap Yard site. Specifically, they consist of (1) physical hazards, (2) radiological contamination, (3) PCBs, (4) organic analytes, (5) drums, (6) asbestos, and (7) miscellaneous pollutants.

### *Physical Hazards*

- Hazards of this type include localized pockets of sharp pieces of metal and broken glass on the ground surface. In grid block -1+00, 500L, an identified region of surface contamination contained a myriad of contaminated debris including metal, plastic, and glassware [including a glass syringe (analytical chemistry variety)]. No needles were detected on-site.

### ***Radiological Contamination***

- Surface measurements and sample analysis results identified a variety of radiological findings. Widespread clusters of small, localized radioactive hot spots were found throughout most of the accessible areas of the site. The most numerous and concentrated regions of contamination encompassing several grid blocks were identified north of Hot Yard Road. Results show grid location 1+00, 700L to be the most contaminated grid block north of Hot Yard Road. Three localized surface hot spots with gamma exposure rates of 12, 6.2, and 1.5 mR/h were found. Highest ground-surface beta-gamma dose rate measurements (85 mrad/h) were recorded in the same grid block (see Fig. 5.1).
- Radioactive, green-colored aggregate lumps of material located north of Hot Yard Road (grid location 7+79, 177L), were found in what appears to be an old wood-framed air filter lying on the ground surface. Measurements on contact with a plastic bag containing a sample of this material showed gamma exposure rates of up to 2.5 mR/h; beta-gamma dose rates measured 7 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~40% by weight (probable composition, a mixture of uranium fluoride and uranium oxide compounds; sample B2).
- On the top side of a large, oblong concrete structure immediately north of and adjacent to Hot Yard Road (grid location 6+44, 20L), a coarse, yellowish-gray material was found to be radioactive. Gamma radiation measurements on contact with a plastic bag containing a sample of this material showed exposure rates of up to 5 mR/h; beta-gamma dose rates measured 15 mrad/h. Isotope dilution/mass spectrometry analysis results show uranium concentrations of ~80% by weight (composition, uranyl hydroxide; sample B3).
- Isotope dilution/mass spectrometry analysis of samples B1A, B1B, B4, and B5 show enriched levels of the  $^{235}\text{U}$  isotope (see Table 4.3). Grid locations for these samples are 3+11, 200L (B1A and B1B), 12+40, 160L (B4), and 5+95, 238L (B5). Levels of ~15 atomic percent  $^{235}\text{U}$  contributed toward the total uranium content of sample B4.
- Survey findings suggest the off-site migration of low levels of  $^{238}\text{U}$  by means of a wet-weather stream on the west side of WAG 11 (Fig. 5.2). At this location, outside of the WAG 11 rope boundary, gamma exposure rates of up to 29  $\mu\text{R/h}$  follow the ephemeral stream with contiguous contamination extending west beneath Old Country Road. A streambed soil sample and a water sample were collected approximately 120 ft and 220 ft, respectively, from the west rope boundary. Analytical results indicate no detectable radionuclide concentrations above typical background levels in the water sample; however,  $^{238}\text{U}$  concentrations of 100 pCi/g were measured in the streambed sample. For comparison purposes, surface soil concentrations of  $^{238}\text{U}$  in Tennessee range from 0.72 to 1.3 pCi/g and average 1.0 pCi/g.<sup>6</sup>

K/PHOTO 90-1802



Fig. 5.1. Flag indicating location of highest surface hot spot measurements (85 mrad/h; 12 mR/h) at the White Wing Scrap Yard site (June 1990).

ORNL-PHOTO 7062-91



Fig. 5.2. View looking west at streambed of ephemeral stream with gamma exposure rates of up to 29  $\mu\text{R/h}$  located outside the WAG 11 rope boundary (July 1991).

- It should be noted that during the course of this investigation, some evidence of residual removable contamination was detected as survey personnel were screened for radioactive contamination prior to exiting the site. During the soil sampling process, transferable beta-gamma contamination was detected on shoe covers. In grid blocks 10+00, BL and 11+00, 100R, a contaminated region included a piece of ceramic material with measurable transferable alpha contamination levels of 49 dpm/100 cm<sup>2</sup>. This value exceeds the 20 dpm/100 cm<sup>2</sup> ORNL guideline (based on the limit for transuranics) as well as the Y-12 Plant Action Value of 25 dpm/100 cm<sup>2</sup> (based on uranium for removable surface contamination in nonradiological areas).<sup>7</sup>
- It is likely that residual radiological contamination is present beneath a gravel road that provides access to a water quality well [well number 1139, E28,701 (ft) /N34,508 (ft)]. The access road adjoins Hot Yard Road at grid location 10+00, BL. Contaminated surface regions were identified adjacent to the gravel road, and several discrete spots of slightly elevated gamma exposure rates were found on the road surface. Although the gravel material provides some shielding, increased usage of the road during remedial and/or corrective actions at the site may result in the redistribution of gravel material and subsequent suspension of contaminated dust.

### *Polychlorinated Biphenyls*

- Survey findings punctuate the need for a more thorough site assessment of possible hazardous waste contamination. The potential for subsurface soil and groundwater contamination from fugitive hazardous waste exists because of the types and large quantities of scrap debris that have been and continue to be subjected to erosion by wind and water. Subsurface drilling into suspect areas, including appropriate chemical analysis (i.e., organics, inorganics, and RCRA analytes) and analysis of radiological constituents of core samples, should be conducted.
- The presence of PCBs (~10 ppm per sample) was demonstrated in three soil samples collected from a region of dead vegetation (Fig. 5.3) at the former K-25 scrapping operations area (samples B13, B14, and B15). Analysis demonstrated the presence of PCBs in the form of Aroclor 1254 (ranging from 6.6 to 9.3 ppm) and Aroclor 1260 (ranging from 1.4 to 3.6 ppm). These results were immediately reported to the ORNL ERP and to Environmental, Health, and Safety Compliance personnel.\* In this region, surface vegetation including several small trees were reportedly poisoned from the toxic effect of residual acids and/or alkalies used in the process of decontaminating radioactive scrap material. Additionally, phytotoxic metal residues may be present in soil layers.

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\*There are no federal or state regulations giving acceptable levels of PCBs in soil. However, in the EPA Toxic Substances Control Act (TSCA) PCB spill cleanup policy (52 FR 10688), it is recommended that cleanup standards of 25 ppm be set for PCBs at sites with restricted access and 10 ppm at sites considered for residential or unrestricted access.<sup>8</sup> In a guidance document,<sup>9</sup> EPA recommends setting remedial action goals between 10 and 25 ppm.<sup>10</sup>

K/PHOTO 90-1800



Fig. 5.3. View of scattered debris in a region of dead vegetation located in the K-25 area of the White Wing Scrap Yard site (June 1990).

- In grid block 13+00, 300L at the former Y-12 scrapping operations area, an old transformer/capacitor device partially covered with a dark, oily substance, was found on the ground surface (see Fig. 5.4). This finding further suggests possible PCB contamination and the potential for additional PCB sources on-site.

#### *Organic Analytes*

- Three surface soil samples (B13, B14, and B15) collected from a region of dead vegetation (Fig. 5.3) were submitted for analysis. Results of analytical screening for volatile and semivolatile organics show that only three compounds were detected at concentrations above quantitation limits. The two volatile compounds, methylene chloride and acetone, and the semivolatile bis(2-ethylhexyl)phthalate were detected at levels above their respective quantitation limits. The types and low concentrations of these organics indicate that they originated as common laboratory contaminants.

#### *Drums*

- In a wooded area north of Hot Yard Road (grid location 6+14, 100L), a small ( $\sim 1\text{-m}^2$ ) area of surface subsidence (5 ft in depth) revealed portions of several buried, 55-gal metal drums (see Fig. 5.5). No significant elevation of beta-gamma dose rates was detected in the hole, although beta-gamma dose rates were slightly above typical background.
- Subsequent to preliminary findings of this survey, corrective measures involved the removal of several 55-gal metal drums found in the creek south of Hot Yard Road. A follow-up gamma scanning survey along the creek bank revealed two drums lodged in the creek bank soil. Gamma radiation measurements along the creek bank indicate generally typical background levels.

#### *Asbestos*

- Long narrow strips of apparent asbestos material were found on the ground surface and/or partially buried in the soil matrix at several locations north of Hot Yard Road.
- A 55-gal metal drum containing apparent asbestos material was found in the former ORNL scrapping operations area south of Hot Yard Road. Verification of asbestos and identification analysis for specific asbestos fibers by ORNL Industrial Hygiene personnel cannot be completed because these materials were radioactively contaminated.<sup>11</sup> Elevated beta-gamma dose rates were measured on contact with the plastic sample bag. There is a low probability of airborne asbestos hazards due to the solid texture of the asbestos material.

ORNL-PHOTO 386-90



Fig. 5.4. View of surface debris, including an old transformer/capacitor device, at the White Wing Scrap Yard site (January 1990).

ORNL-PHOTO 404-90



Fig. 5.5. View of ground-surface subsidence where buried metal drums were found at the White Wing Scrap Yard site (January 1990). Reportedly this region was used by the K-25 Site.

- In grid block 10+00, 100R, contaminated material includes pieces of apparent asbestos-containing board and cloth with beta-gamma dose rates reaching 1.5 mrad/h.
- Grid block 13+00, 100L was littered with slightly contaminated asbestos material.

### *Miscellaneous Pollutants*

- Newly accessible areas of block 10+00, 200R revealed a partially buried piece of lead (~1/2 in. thick) with a slightly elevated beta-gamma dose rates (0.1 mrad/h) located beside a gravel access road.
- A small, sealed gray metal box showing contact beta-gamma dose rates of 9 mrad/h was found in grid block 1+00, 600L. "Determined to be Cadmium" was inscribed on the exterior of the box. After the box was carefully opened, interior measurements showed very low levels of radioactivity. Gamma spectrometry screening analysis of a smear sample collected from the exterior surface identified  $^{238}\text{U}$  as the primary contaminant.
- A sealed glass bottle containing an unidentified liquid was found at the former ORNL scrapping operations area (grid block 9+00, 300R). Contents of the bottle were not identified; the item was left on-site.

In general, the results of this cursory investigation show widespread distribution of surface contamination throughout the site. The presence and nature of uranium contamination (i.e., uranium enriched in the isotope  $^{235}\text{U}$ ) identified in samples collected north of Hot Yard Road suggest this waste type originated from the K-25 and the Y-12 plants. Additional subsurface soil sampling with subsequent radiological analysis and radiation measurements of surface debris are necessary to fully characterize the site and roughly determine the waste operator responsible for specific waste types. However, the presence of elevated concentrations of  $^{238}\text{U}$  in soil taken south of Hot Yard Road (former ORNL scrapping operations area) and elevated concentrations of  $^{137}\text{Cs}$  northwest of Hot Yard Road (former K-25 scrapping operations area) suggest designated scrapping operational boundaries were not strictly adhered to, and/or these facilities managed a variety of radionuclides. For example, in the 1950s, the K-25 plant provided research and development (R&D) work on the recovery of uranium from Hanford operations spent fuel solutions. The solutions contained isotopes of uranium, transuranics, and uranium fission products. Radioactive elements such as neptunium, californium, traces of plutonium, cesium, and technetium were present. A 750-gal stainless steel tank contained in concrete (termed a "hot pit" used for waste storage) was removed from the K-25 plant and, reportedly, relocated to the White Wing Scrap Yard area for storage.<sup>12</sup>

Although no samples collected south of Hot Yard Road were analyzed for the presence of plutonium, there is a high probability that plutonium-contaminated surface and subsurface soil exists.<sup>7</sup>

## 6. RECOMMENDATIONS FOR CORRECTIVE ACTIONS

The presence of elevated gamma exposure rates at the ground surface, verified uranium contamination in sampled soil, radioactively contaminated debris on the ground surface and in the soil matrix, and physical hazards throughout the surface of the site warrant immediate corrective actions. This conclusion is based exclusively on the results of this survey, which should be considered an interim assessment pending a more detailed radiological and hazardous waste characterization of the WAG 11 area. Because a scoping survey is considered a limited, cursory investigation, the data and subsequent assessment of data presented in this report should be considered only a "snapshot" representation of the site during the dates of the survey.

Two basic approaches to interim corrective actions are (1) isolation of the entire WAG 11 area (e.g., fencing), including measures to minimize the dispersion and/or redistribution of fugitive radionuclides, and (2) removal, treatment (if required) and disposal of contaminated material (e.g., soil, ground cover, and scrap debris), and subsequent stabilization of the treated areas. Health risk assessments should be conducted and used in the evaluation of remedial action options. Because significant concentrations of radionuclides ( $^{238}\text{U}$  and  $^{137}\text{Cs}$ ) were confirmed in sampled soil, the removal, treatment, and disposal of contaminated waste may pose a greater health risk than leaving it in situ. A "leave-in-place" option, coupled with the application of proven, demonstrable technologies for long-term stabilization and/or reduction of radiation exposures, should be considered for contaminated areas.

It should be noted that a 1967 aerial photograph of the scrap yard site (Fig. 2.3) shows apparent scrap material storage outside (east and south) of the existing WAG 11 boundary. On the basis of this information and the large number of inaccessible areas throughout the site, we recommend that an updated aerial radiological survey be conducted in conjunction with a magnetometer survey (for detection of metal). The results of these surveys would provide useful information in evaluating the current radiological/surface metal assessment of the WAG 11 area. In addition, survey measurements reveal surface contamination extending outside the western and northern WAG 11 boundary but inside the rope boundary. The WAG 11 boundary should be relocated to encompass the contiguous contamination.

Corrective action options listed below consist of ground-surface measures to limit human exposures, minimize surficial dispersion of radiological contamination, and monitor any such dispersion. Not every contamination situation would involve the implementation of all recommendations listed below; rather, the recommendations should be considered individually or in appropriate combinations. A more detailed investigation (with core hole borings and soil analysis) would be required to fully characterize the radiological and hazardous waste status of WAG 11 and to address the most appropriate methods for effective, long-term remediation. The primary concern in assessing appropriate corrective actions is the minimization of exposures of personnel to radiation. These recommendations are in accordance with the radiation safety policy of ORNL to conduct all operations in

such a manner that personnel exposures to radiation are maintained at a level as low as reasonably achievable (ALARA).

It is not within the scope of this investigation to identify and/or correlate federal and state environmental laws and their applicability for a suggested corrective action; however, it is important to mention that any removable and/or remedial action at the White Wing Scrap Yard site must be in accord with applicable federal and state laws and DOE orders. The reference section includes two detailed sources listing major environmental laws<sup>8</sup> and proposed guidance for remedial action strategies at sites previously contaminated with radioactive materials at ORNL.<sup>13</sup>

#### *Isolation and identification of contaminated areas*

- Radiation control measures (e.g., roping) should be considered for intra-WAG contaminated land areas exhibiting high surface gamma exposure rates. Warning signs should be posted with instructions to contact the Radiation Protection Section of the Office of Environmental and Health Protection before entering these areas. Based on recommendations outlined by ORNL Health Physics, "Radiation Hazard—Keep Out" signs would be applicable. This type of warning sign is used primarily to warn the general Laboratory population and the public where access to an area is limited to authorized personnel who have the training necessary to safely perform their job functions within the area.
- Radiation control measures at the WAG 11 area boundary are recommended. A new fence encompassing the entire WAG 11 area should replace the existing dilapidated fence. Wire strands of the fence should be placarded with "Radiation Hazard—Keep Out" signs.
- Currently, the scrap yard site can be accessed via several entrances. The presence of contaminated soil and debris found throughout the site warrants stringent entrance requirements (e.g., metal gates). Access into the scrap yard area should be restricted and the number of zone portals (point of entrance and exit) limited. Because the WAG area is accessed only for maintenance and monitoring activities, a controlled "exclusion area" should be considered until decisions are reached for appropriate site corrective measures and/or remedial actions.
- A diagram of the radiological surface conditions of WAG 11, depicting current surface radiation levels including surface hot spots (such as Fig. 4.1), should be maintained, updated, and made readily available to authorized personnel requiring access into the scrap yard area. Consideration should be given to posting such information at a highly visible location on-site (e.g., west Hot Yard Road entrance). Instructions to contact responsible area personnel (e.g., ORNL Health Physics personnel and ORNL ERP) with current telephone numbers should be included.
- If remedial or cleanup actions are not implemented, active and passive institutional control measures should be maintained for a specified period of time to allow for

radioactive decay of intermediate-lived fission waste products such as  $^{137}\text{Cs}$ . Long-term institutional control ( $\sim 300$  years) would result in a 99% reduction of  $^{137}\text{Cs}$  activity ( $\sim 10$  half-lives). Periodic monitoring for fugitive radionuclides in soil, vegetation, surface water, sediment, and groundwater should be performed.

- High concentrations of uranium, uranium isotopes, and uranium compounds measured in soil/rock samples from the site indicate that a potential long-term problem exists (the half-life of  $^{238}\text{U}$  is  $4.5 \times 10^9$  years). It is therefore recommended that identified uranium contamination in soil be remediated because long-term institutional control measures are impractical and unrealistic.
- Radiation protection measures (e.g., personal radiation monitoring devices) should be considered for personnel not affiliated with Martin Marietta Energy Systems, Inc., who are involved with activities at the White Wing Scrap Yard area. (Note: Energy Systems personnel are required to wear badge dosimeters.) All activities that disturb and/or disperse radioactivity at WAG 11 should cease if personnel involved with such operations (e.g., well drilling) do not wear some type of radiation protection gear. Personal respirators would minimize the potential for inhalation of radioactively contaminated soil/dust particles.
- Land stabilization procedures (e.g., earthen caps, hydrologic isolation, and limited in situ grouting or vitrification) should be considered at radioactively contaminated soil areas where high concentrations of intermediate-lived waste products have been verified.
- External radiation levels could be reduced at contaminated areas by covering contaminated ground-surface areas with clean, uncontaminated soil. However, if eventual remedial action requires removal of contaminated soil, the added cover would increase the volume of waste to be disposed of.
- It is recommended that systematic sampling of vegetation and subsequent radionuclide analysis be conducted throughout WAG 11. Additionally, we recommend systematic (surface and subsurface) soil sampling south of Hot Yard Road for subsequent gross alpha analysis. Particular emphasis should be given to analyzing the samples for the presence of  $^{239}\text{Pu}$ .

#### ***Removal, treatment, and disposal of contaminated material***

- At the highly contaminated land regions, soil and scrap/soil matrix materials could be removed, treated (if required), and disposed of in a designated radioactive waste disposal site. Excavation and removal of the contaminated material must be carried out in full compliance with current guidelines. It is essential that ORNL Health Physics personnel be present to monitor activities associated with any disturbance of soil at the White Wing Scrap Yard site.

*Verification of drum contents and drum removal*

- Isolation procedures (i.e., roping) should be considered at the area of surface subsidence prior to mixed-waste analysis and subsequent verification of drum contents. Detailed subsurface characterization of this immediate area is recommended prior to drum removal. Additionally, radioactively contaminated metal drums found on the ground surface should be removed and disposed of in a designated radioactive waste disposal site. All drums found on site, particularly the few identified in the creek-bank area (south of Hot Yard Road), should be removed and properly disposed.

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## Appendix A

### GRID COORDINATES AND ADDITIONAL SAMPLE ANALYSIS DATA



Table A.1. Survey grid coordinates and corresponding Y-12 master grid system coordinates at the White Wing Scrap Yard site

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
0+00, BL	34,833	27,665
0+00, 100L	34,932	27,652
0+00, 200L	35,031	27,638
0+00, 300L	35,130	27,624
0+00, 400L	35,229	27,610
0+00, 500L	35,328	27,596
0+00, 600L	35,427	27,583
0+00, 700L	35,526	27,569
0+00, 800L	35,625	27,555
0+00, 900L	35,724	27,541
1+00, BL	34,847	27,764
1+00, 100L	34,946	27,751
1+00, 200L	35,045	27,737
1+00, 300L	35,144	27,723
1+00, 400L	35,243	27,709
1+00, 500L	35,342	27,695
1+00, 600L	35,441	27,682
1+00, 700L	35,540	27,668
1+00, 800L	35,639	27,654
1+00, 900L	35,738	27,640
1+00, 100R	34,798	27,778
2+00, BL	34,861	27,864
2+00, 100L	34,960	27,850
2+00, 200L	35,059	27,836
2+00, 300L	35,158	27,882
2+00, 400L	35,257	27,808
2+00, 500L	35,356	27,795
2+00, 600L	35,455	27,781
2+00, 700L	35,554	27,767
2+00, 800L	35,653	27,753
2+00, 900L	35,752	27,739
2+00, 100R	34,762	27,877

Table A.1 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
3+00, BL	34,874	27,963
3+00, 100L	34,973	27,949
3+00, 200L	35,072	27,935
3+00, 300L	35,172	27,921
3+00, 400L	35,271	27,907
3+00, 500L	35,370	27,894
3+00, 600L	35,469	27,880
3+00, 700L	35,568	27,866
3+00, 800L	35,667	27,852
3+00, 900L	35,766	27,838
3+00, 100R	34,775	27,976
4+00, BL	34,888	28,062
4+00, 100L	34,987	28,048
4+00, 200L	35,086	28,034
4+00, 300L	35,185	28,020
4+00, 400L	35,284	28,006
4+00, 500L	35,383	27,993
4+00, 600L	35,482	27,979
4+00, 700L	35,581	27,965
4+00, 800L	35,681	27,951
4+00, 900L	35,780	27,937
4+00, 100R	34,789	28,075
5+00, BL	34,902	28,161
5+00, 100L	35,001	28,147
5+00, 200L	35,100	28,133
5+00, 300L	35,199	28,119
5+00, 400L	35,298	28,105
5+00, 500L	35,397	28,092
5+00, 600L	35,496	28,078
5+00, 700L	35,595	28,064
5+00, 800L	35,694	28,050
5+00, 900L	35,793	28,036
5+00, 100R	34,803	28,174
5+00, 200R	34,704	28,188

Table A.1 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
6+00, BL	34,916	28,260
6+00, 100L	35,015	28,246
6+00, 200L	35,114	28,232
6+00, 300L	35,213	28,218
6+00, 400L	35,312	28,205
6+00, 500L	35,411	28,191
6+00, 600L	35,510	28,177
6+00, 700L	35,609	28,163
6+00, 800L	35,708	28,149
6+00, 900L	35,807	28,136
6+00, 100R	34,817	28,274
6+00, 200R	34,718	28,287
7+00, BL	34,930	28,359
7+00, 100L	35,029	28,345
7+00, 200L	35,128	28,331
7+00, 300L	35,227	28,317
7+00, 400L	35,326	28,304
7+00, 500L	35,425	28,290
7+00, 600L	35,524	28,276
7+00, 700L	35,623	28,262
7+00, 800L	35,722	28,248
7+00, 900L	35,821	28,235
7+00, 100R	34,831	28,373
7+00, 200R	34,732	28,386
8+00, BL	34,943	28,458
8+00, 100L	35,042	28,444
8+00, 200L	35,141	28,430
8+00, 300L	35,241	28,416
8+00, 400L	35,340	28,403
8+00, 500L	35,439	28,389
8+00, 600L	35,538	28,375
8+00, 700L	35,637	28,361
8+00, 800L	35,736	28,347
8+00, 900L	35,835	28,334

Table A.1 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
8+00, 100R	34,844	28,472
8+00, 200R	34,745	28,485
8+00, 300R	34,646	28,499
9+00, BL	34,957	28,557
9+00, 100L	35,056	28,543
9+00, 200L	35,155	28,529
9+00, 300L	35,254	28,515
9+00, 400L	35,353	28,502
9+00, 500L	35,452	28,488
9+00, 100R	34,858	28,571
9+00, 200R	34,759	28,584
9+00, 300R	34,660	28,598
9+00, 400R	34,561	28,612
9+00, 500R	34,462	28,626
10+00, BL	34,971	28,656
10+00, 100L	35,070	28,642
10+00, 200L	35,169	28,628
10+00, 300L	35,268	28,614
10+00, 400L	35,367	28,601
10+00, 500L	35,466	28,587
10+00, 100R	34,872	28,670
10+00, 200R	34,773	28,683
10+00, 300R	34,674	28,697
10+00, 400R	34,575	28,711
10+00, 500R	34,476	28,725
11+00, BL	34,985	28,755
11+00, 100L	35,084	28,741
11+00, 200L	35,183	28,777
11+00, 300L	35,282	28,714
11+00, 400L	35,381	28,700
11+00, 500L	35,480	28,686

Table A.1 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
11+00, 100R	34,886	28,769
11+00, 200R	34,787	28,783
11+00, 300R	34,688	28,796
11+00, 400R	34,589	28,810
12+00, BL	34,999	28,854
12+00, 100L	35,098	28,840
12+00, 200L	35,197	28,826
12+00, 300L	35,296	28,813
12+00, 400L	35,395	28,799
12+00, 500L	35,494	28,785
12+00, 100R	34,900	28,868
12+00, 200R	34,801	28,882
12+00, 300R	34,701	28,895
12+00, 400R	34,602	28,909
13+00, BL	35,012	28,953
13+00, 100L	35,111	28,939
13+00, 200L	35,210	28,925
13+00, 300L	35,310	28,912
13+00, 400L	35,409	28,898
13+00, 500L	35,508	28,884
13+00, 100R	34,913	28,967
13+00, 200R	34,814	28,981
13+00, 300R	34,715	28,994
13+00, 400R	34,616	29,008
14+00, BL	35,026	29,052
14+00, 100L	35,125	29,038
14+00, 200L	35,224	29,024
14+00, 300L	35,323	29,011
14+00, 400L	35,422	28,997
14+00, 500L	35,521	28,983

Table A.1 (continued)

Grid point <sup>a</sup>	Location <sup>b</sup>	
	North	East
14+00, 100R	34,927	29,066
14+00, 200R	34,828	29,080
14+00, 300R	34,729	29,093
14+00, 400R	34,630	29,107
		29,151
15+00, 100L	35,139	29,137
15+00, 200L	35,238	29,123
15+00, 300L	35,337	29,110
15+00, 400L	35,436	29,096
15+00, 100R	34,941	29,165
15+00, 200R	34,842	29,179
15+00, 300R	34,743	29,192
15+00, 400R	34,644	29,206
16+00, BL	35,054	29,250
16+00, 100L	35,153	29,236
16+00, 200L	35,252	29,223
16+00, 300L	35,351	29,209
16+00, 100R	34,955	29,264
16+00, 200R	34,856	29,278
16+00, 300R	34,757	29,292
17+00, BL	35,068	29,349
17+00, 100R	34,969	29,363
17+00, 200R	34,870	29,377

<sup>a</sup>Grid blocks are shown on Fig. 3.1.<sup>b</sup>Y-12 grid coordinates measured in feet.

Table A.2. Concentrations of Silvex, 2,4-D, and Aroclor<sup>a</sup> in soil samples collected at the White Wing Scrap Yard site

Sample ID	Location <sup>b</sup>	Concentration			
		2,4,5-TP (Silvex) <sup>c</sup> ( $\mu\text{g/g}$ )	2,4-D <sup>c</sup> ( $\mu\text{g/g}$ )	Aroclor 1254 (ppm)	Aroclor 1260 (ppm)
B13	1+13, 647L	<2.8	<5.0	6.65	3.62
B14	1+39, 622L	<2.8	<5.0	9.30	1.57
B15	1+50, 567L	<2.8	<5.0	6.62	1.36

<sup>a</sup>Trademark for a series of polychlorinated polyphenols.

<sup>b</sup>Locations are shown on Fig. 4.1.

<sup>c</sup>Analyzed according to procedure number 8150.

Table A.3. Tentatively identified compounds found in soil samples  
from the White Wing Scrap Yard site

Compound name	Retention time (min)	Concentration ( $\mu\text{g/kg}$ )	Qualifier <sup>a</sup>
<i>Semivolatile organic analysis</i>			
<i>Sample B13</i>			
unknown	8.07	940	J
unknown	9.79	150	J
unknown	10.36	63	J
unknown	23.64	44	J
unknown	23.72	36	J
unknown	27.83	930	J
unknown	28.29	100	J
unknown	30.02	180	J
unknown	31.51	4200	J
unknown	33.47	4100	J
unknown	34.73	390	J
<i>Semivolatile organic analysis</i>			
<i>Sample B14</i>			
unknown	13.95	160	J
unknown	14.20	130	J
camphor	15.16	150	J
unknown	18.93	42	J
1,2,3,5-tetrachloro-4,6-dimethyl-benzene	23.74	38	J
unknown	23.94	77	J
unknown hydrocarbon	24.77	38	J
unknown hydrocarbon	26.26	74	J
unknown hydrocarbon	27.38	49	J
unknown hydrocarbon	27.48	63	J
unknown	27.84	220	J
pentachloro-1,1'-biphenyl	30.03	240	J
unknown	31.51	200	J
unknown	33.48	670	J
<i>Volatile organic analysis</i>			
<i>Sample B14</i>			
carene,(1S,3S,6R)-(-)	18.00	42	J

Table A.3 (continued)

Compound name	Retention time (min)	Concentration ( $\mu\text{gkg}$ )	Qualifier <sup>a</sup>
<i>Semivolatile organic analysis</i>			
<i>Sample B15</i>			
1,1,2,2-tetrachloro ethane	9.78	180	J
trichloro-benzene	15.78	380	J
unknown hydrocarbon	27.36	130	J
unknown	27.82	410	J
tetrachloro-1,1'-biphenyl	28.87	270	J
pentachloro-1,1'-biphenyl	30.01	770	J
pentachloro-1,1'-biphenyl	30.59	980	J
pentachloro-1,1'-biphenyl	31.14	410	J
pentachloro-1,1'-biphenyl	31.27	390	J
pentachloro-1,1'-biphenyl	31.53	2300	J
hexachloro-1,1'-biphenyl	32.12	610	J
pentachloro-1,1'-biphenyl	32.17	1200	J
hexachloro-1,1'-biphenyl	32.72	650	J
hexachloro-1,1'-biphenyl	33.40	930	J
unknown	33.45	1000	J
unknown	36.44	470	J
unknown hydrocarbon	38.35	460	J
unknown hydrocarbon	40.70	480	J

<sup>a</sup> J = Indicates an estimated value with results less than sample quantitation limit but greater than zero.

Table A.4. Results of analyses for volatile organics in soil samples collected at the White Wing Scrap Yard site

Parameter	Chemical Abstracts Service No.	Sample number <sup>a,b</sup> ( $\mu\text{g/kg}$ )		
		B13	B14	B15
1,1,1-trichloroethane	71-55-6	U	U	U
1,1,2,2-tetrachloroethane	79-34-5	U	U	U
1,1,2-trichloroethane	79-00-5	U	U	U
1,1-dichloroethane	75-34-3	U	U	U
1,1-dichloroethene	75-35-4	U	U	U
1,2-dichloroethane	107-06-2	U	U	U
1,2-dichloroethene (total)	540-59-0	U	U	U
1,2-dichloropropane	78-87-5	U	U	U
2-butanone	78-93-3	U	U	U
2-hexanone	591-78-6	U	U	U
4-methyl-2-pentanone	108-10-1	U	U	U
acetone	67-64-1	8J	9J	11
benzene	71-43-2	U	U	U
bromodichloromethane	75-27-4	U	U	U
bromoform	75-25-2	U	U	U
bromomethane	74-83-9	U	U	U
carbon disulfide	75-15-0	U	U	U
carbon tetrachloride	56-23-5	U	U	U
chlorobenzene	108-90-7	U	U	U
chloroethane	75-00-3	U	U	U
chloroform	67-66-3	U	U	U
chloromethane	74-87-3	U	U	U
cis-1,3-dichloropropene	10061-01-5	U	U	U
dibromochloromethane	124-48-1	U	U	U
ethylbenzene	100-41-4	U	U	U
methylene chloride	75-09-2	13	28	49
styrene	100-42-5	U	U	U
tetrachloroethene	127-18-4	U	U	U
toluene	108-88-3	2J	5J	U
trans-1,3-dichloropropene	10061-02-6	U	U	U
trichloroethene	79-01-6	U	U	U
vinyl acetate	108-05-4	U	9J	7J
vinyl chloride	75-01-4	U	U	U
xylene (total)	1330-20-7	U	U	U

<sup>a</sup>Sample locations are shown on Fig. 4.1.

<sup>b</sup>Key to letter designations:

U = Indicates compound was analyzed for but not detected.

J = Indicates an estimated value with results less than sample quantitation limit but greater than zero.

Table A.5. Results of analyses for base/neutral/acid extractable organics in soil samples collected at the White Wing Scrap Yard site

Parameter <sup>a</sup>	Chemical Abstracts Service No.	Sample number <sup>b,c</sup> ( $\mu\text{g/kg}$ )		
		B13	B14	B15
1,2,4-trichlorobenzene	120-82-1	MS	MS	U
1,2-dichlorobenzene	95-50-1	U	U	U
1,3-dichlorobenzene	541-73-1	U	U	U
1,4-dichlorobenzene	106-46-7	MS	MS	MS
2,4,5-trichlorophenol	95-95-4	U	U	U
2,4,6-trichlorophenol	88-06-2	U	U	U
2,4-dichlorophenol	120-83-2	U	U	U
2,4-dimethylphenol	105-67-9	U	U	U
2,4-dinitrophenol	51-28-5	U	U	U
2,4-dinitrotoluene	121-14-2	MS	MS	MS
2,6-dinitrotoluene	606-20-2	U	U	U
2-chloronaphthalene	91-58-7	U	U	U
2-chlorophenol	95-57-8	U	U	U
2-methylnaphthalene	91-57-6	U	U	U
2-methylphenol	95-48-7	U	U	U
2-nitroaniline	88-74-4	U	U	U
2-nitrophenol	88-75-5	U	U	U
3,3'-dichlorobenzidine	91-94-1	U	U	U
3-nitroaniline	99-09-2	U	U	U
4,6-dinitro-2-methylphenol	534-52-1	U	U	U
4-bromophenyl-phenylether	101-55-3	U	U	U
4-chloro-3-methylphenol	59-50-7	U	U	U
4-chloroaniline	106-47-8	U	U	U
4-chlorophenyl-phenylether	7005-72-3	U	U	U
4-methylphenol	106-44-5	U	U	U
4-nitroaniline	100-01-6	U	U	U
4-nitrophenol	100-02-7	U	U	U
acenaphthene	83-32-9	MS	MS	MS
acenaphthylene	208-96-8	U	U	U
anthracene	120-12-7	U	U	U
benzo(a)anthracene	56-55-3	U	U	U
benzo(a)pyrene	50-32-8	U	U	U
benzo(b)fluoranthene	205-99-2	U	U	U
benzo(g,h,i)perylene	191-24-2	U	U	U
benzo(k)fluoranthene	207-08-9	U	U	U
benzoic acid	65-85-0	U	U	U
benzo alcohol	100-51-6	U	U	U
bis(2-chloroethoxy)methane	111-91-1	U	U	U
bis(2-chloroethyl)ether	111-44-4	U	U	U
bis(2-chloroisopropyl)ether	108-60-1	U	U	U
bis(2-ethylhexyl)phthalate	117-81-7	U	U	430
butylbenzylphthalate	85-68-7	U	U	U
chrysene	218-01-9	U	38J	U

Table A.5 (continued)

Parameter <sup>a</sup>	Chemical Abstracts Service No.	Sample number <sup>b,c</sup> ( $\mu\text{g/kg}$ )		
		B13	B14	B15
di-n-butylphthalate	84-74-2	450B	440B	1200B
di-n-octylphthalate	117-84-0	U	U	U
dibenz(a,h)anthracene	53-70-3	U	U	U
dibenzofuran	132-64-9	U	U	U
diethylphthalate	84-66-2	29JB	29JB	21JB
dimethylphthalate	131-11-3	U	U	U
fluoranthene	206-44-0	U	U	U
fluorene	86-73-7	U	U	U
hexachlorobenzene	118-74-1	U	U	U
hexachlorobutadiene	87-68-3	U	U	U
hexachlorocyclopentadiene	77-47-4	U	U	U
hexachloroethane	67-72-1	U	U	U
indeno(1,2,3-cd)pyrene	193-39-5	U	U	U
isophorone	78-59-1	U	U	U
n-nitroso-di-n-propylamine	621-64-7	MS	MS	MS
n-nitrosodiphenylamine (1)	86-30-6	U	U	U
naphthalene	91-20-3	U	U	U
nitrobenzene	98-95-3	U	U	U
pentachlorophenol	87-86-5	U	U	U
phenanthrene	85-01-8	U	20J	20J
phenol	108-95-2	U	U	U
pyrene	129-00-0	MS	MS	MS

<sup>a</sup>Analyses performed in accordance with U.S. Environmental Protection Agency (EPA) procedure 8270.

<sup>b</sup>Sample locations are shown on Fig. 4.1.

<sup>c</sup>Key to letter designations:

U = Indicates compound was analyzed for but not detected.

MS = Indicates matrix spike, compound added to calculate recovery for quality control purposes.

B = Indicates compound found in both the sample and its associated blank. It indicates possible/probable blank contamination and warns the data user to take appropriate action. This flag must be used for a tentatively identified compound as well as for a positively identified compound on the target compound list.

J = Indicates an estimated value with results less than sample quantitation limit but greater than zero.

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